Programmer's Manual

FormsPro 4300
FormsPro 4500
FormsPro 4503

Serial Matrix Printers

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by

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CHAPTER 1 - INTRODUCTION

This manual describes the software interfaces supported by your FormsPro 4000 series printer. It is written for a programmer who will be developing software for the printer, and contains information not normally needed by a printer operator/user.

Basic information on printer operation (setting the printer up, loading paper, replacing ribbons, etc.) can be found in the "Operator's Manual" that accompanied your printer.

How to Use This Manual

Below is a brief description of the information contained in this manual.

Chapter 1 **Introduction**

Describes the contents of this manual. Also provides you with an introduction to the capabilities and operation of the FormsPro 4300. FormsPro 4500, and FormsPro 4503 printers.

Chapters 2 through 7 **Emulations**

Describe the software interface when using ANSI X3.64, Epson FX, IBM Proprinter, DEC LA120, Simple TTY, or Printek emulation mode.

Each of these chapters is designed as a stand-alone chapter, capable of providing all the information necessary to write software for a particular emulation. You may want to read the chapter for the emulation(s) you are using, and skip the others.

Chapter 8 **Hex Dump Mode**

Describes the output of hex dump mode, and how it may be used to debug software problems.

Appendices

Following the above chapters are appendices containing ASCII character tables and font samples, additional control panel features, how to use the basic bar coding support, printer specifications, and detailed interface specifications for the optional interfaces.

Glossary

For your convenience a glossary of printer related terms may be found in the rear of the manual.

Printer Model Descriptions and Key Features

The Printek FormsPro 4000 Series Printers are high speed, heavy duty serial dot matrix printers designed especially for printing upon hard to print forms which are often not printed adequately by other printers. Of course, the FormsPro 4000 series printers will also print on lighter forms.

All printers provide straight paper paths for jam free paper motion and a zero waste tear bar for demand document applications.

The operator may permanently record up to ten complete sets of form parameters which may be later selected either at the printer's control panel or from the host computer. The FormsPro 4503 provides three sets of tractors, any of which can be included in the form parameters for a particular form. This allows the printer to automatically unload one form and load another when selected, without requiring the operator to touch the paper.

The printers come equipped with an industry standard parallel interface and an RS-232C serial interface. The printers may optionally be ordered with an RS-422 serial interface, or a coaxial/twinaxial interface which emulates an IBM 3287 printer or an IBM 4214, 5225, or 5256 printer.

Other options include a 32K buffer which increases the standard 4K character input buffer to 28K characters, and internal bar code support which also includes the optional OCR-A and OCR-B fonts.

A specially designed print stand which holds multiple paper supplies is also available.

Selecting Emulations

The software interface of the printer varies, depending upon which emulation is selected.

The default emulation, selected at power up, is specified by the "Mode:" value in the "Setup: INTERFACE" menu. Frequently, the desired emulation is specified here, and never changed again.

It is also possible to switch back and forth between various emulations in order to use the unique features of each. A different emulation may be selected via software with the **ESC ESC *n*** sequence.

Although switching emulations is essentially a seamless process, the fundamental differences between emulations may cause unanticipated results. For example, character size may vary, or tabs may work differently.

Changing Forms/Tractor Paths

As mentioned above, the FormsPro 4000 series printers have ten complete sets of forms parameters. These different parameters, or forms, may be selected either from the front panel or with escape sequences. In the FormsPro 4503, selecting a different form may also select a different tractor path. The tractor path is one of the parameters which may be set for each of the ten forms in the "Setup: FORMS" menu using Setup as described in the FormsPro 4000 Series Operator's Manual.

Escape sequences for loading forms are only available in the Epson and Printek emulations. In either chapter refer to the "Load Form" escape sequence in the "Forms and Tractors" section.

If you are using an emulation other than Epson or Printek, you may temporarily change emulations as described above, load the new form, and then return to the previous emulation. An example of this may be found in the "Emulations" section at the end of each of the emulation chapters.

ANSI X3.64 EMULATION

Introduction

This section describes the control codes and escape sequences comprising ANSI X3.64 emulation. This emulation may be selected by specifying "Mode: ANSI X3.64" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 1** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

Many ANSI escape sequences begin with a two character Control Sequence Introducer (CSI), Escape Left Square Bracket (**ESC [**, 1B 5B hex). If 8-bit data is selected via control panel setup, these two characters may be replaced by a single character CSI, 9B hex. The sequences are always documented in this section with the two character CSI (**ESC [**), because this format seems to be much more common, and works equally well with 7-bit or 8-bit data.

Some escape sequences accept one or more numeric parameters. A numeric parameter is a decimal number represented by a string of ASCII decimal digits ("0" through "9"). Leading zeros may be supplied, but are not necessary. Due to implementation constraints, the largest value that can be accepted is decimal 255. Larger values will be treated as zero. Omitting a numeric parameter is equivalent to supplying a value of zero.

If a sequence accepts one numeric parameter, it will be represented as "*n*". If a sequence accepts more than one numeric parameter, they will be represented as "*n1; n2; ... nx*". Note that multiple numeric parameters are separated by a semicolon.

Most ANSI escape sequences will assume one of the following formats:

ESC ***f***	(no numeric parameters)
ESC ***n f***	(one numeric parameter)
ESC ***n1*****;** ***n2*****; ...** ***nx f***	(two or more numeric parameters)

The "*f*" at the end of the escape sequence represents the final character. It terminates the sequence, and specifies the function to be performed.

Spaces are used when documenting escape sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*" and "*f*" above) are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **BS** is the Backspace control code (08 hex), not the two characters "B" and "S" (42 and 53 hex). An ASCII Control Code Table is contained in the appendices for your convenience. If you have any doubt about how to interpret a documented control code or escape sequence, refer to the hex representation in the provided example. This should clarify any ambiguity. The examples may also be helpful when analyzing a hex dump (see chapter 8) printed by the printer.

Some escape sequences refer to the active column or active line. The active column is the column where the next character will be printed. Printing a character or a space will increment the active column. The active line is the line where the next character will be printed. A line feed will increment the active line. Column and line numbers begin at one, not at zero.

Control Codes and Escape Sequences Grouped by Function

Communications

End of Text **ETX**

If "ETX/ACK: On" is specified in the "Setup: INTERFACE" menu, then receipt of an ETX causes the printer to transmit an ACK to the host computer.

Since the ETX may be a legal value within an escape sequence, it is the user's responsibility to ensure that an ETX used for data handshake is not sent within an escape sequence. The user must also ensure that the maximum block size or the number of blocks sent at one time does not exceed the input buffer size of the printer.

ETX/ACK handshake is available only with serial I/O. It is not available when using the parallel interface or the coaxial/twinaxial interface.

Control code:	ETX
Hexadecimal:	03

Character Size and Line Spacing

Set Character and Line Spacing **ESC [*n1* ; *n2* SP G**

Sets the character and line spacing in decipoints (1/720 of an inch). The first parameter, *n1*, sets the line spacing. The second parameter, *n2*, sets the character spacing. Typical values for *n1* and supported values for *n2* are shown below. Other values for *n2* will be ignored. To change only the horizontal or only the vertical spacing, omit the other value from the sequence or set it to zero. Overrides the "CPI:" value and the "LPI:" value in the "Setup: FORM" menu.

n1	line pitch
120	6 lpi
90	8 lpi

n2	character pitch
72	10 cpi
60	12 cpi
54	13.3 cpi
48	15 cpi
43	16.74 cpi
42	17.14 cpi
36	20 cpi

Example: The following escape sequence will select 6 lpi and 10 cpi.

Escape Sequence:	ESC	[	1	2	0	;	7	2	SP	G
Hexadecimal:	1B	5B	31	32	30	3B	37	32	20	47

Example: The following escape sequence will select 6 lpi without affecting character spacing.

Escape Sequence:	ESC	[	1	2	0	SP	G
Hexadecimal:	1B	5B	31	32	30	20	47

Example: The following escape sequence will select 10 cpi without affecting line spacing.

Escape Sequence:	ESC	[	;	7	2	SP	G
Hexadecimal:	1B	5B	3B	37	32	20	47

Character Attributes

Select Graphic Rendition **ESC [*n* m**

Selects the graphic rendition *n* from the following table.

n	Rendition
0	Normal
1	Emphasized
3	Italic
4	Underline

For italic mode to work correctly, an Epson FX font must be selected (check the "Font:" value in the "Setup: FORM" menu). The other available fonts do not include italic characters.

Example: The following escape sequence will select emphasized mode.

Escape Sequence:	ESC	[	1	m
Hexadecimal:	1B	5B	31	6D

Horizontal Position

Carriage Return — CR

Causes the current line to be printed, and then sets the current print position to the left margin. If "Auto LF: On" is selected in the "Setup: INTERFACE" menu, a line feed will also be performed.

Control code: CR
Hexadecimal: 0D

Backspace — BS

Causes the current line to be printed, and then moves the current print position one space to the left. The actual distance moved depends on the current character spacing. Backspacing can be done up to, but not beyond, the left margin.

Control code: BS
Hexadecimal: 08

Absolute Horizontal Tab — ESC [*n* `

Sets the current print position to column *n*. The actual position will depend on the current character spacing. If *n* is less than the left margin, the active column will be set to the left margin. If *n* is greater than the right margin, then a line feed will be performed and the active column will be set to the left margin.

Example: The following escape sequence will set the active column to column 65.

Escape Sequence:	ESC	[	6	5	`
Hexadecimal:	1B	5B	36	35	60

Relative Horizontal Tab — ESC [*n* a

Advances the current print position by *n* columns. The actual distance moved will depend on the current character spacing. Equivalent to sending *n* spaces (SP).

Example: The following escape sequence will advance the active column by 10 columns. If current character spacing is 10 cpi, this will cause the print position to move one inch to the right.

Escape Sequence:	ESC	[	1	0	a
Hexadecimal:	1B	5B	31	30	61

Vertical Position

Line Feed **LF**
(or) **IND**
(or) **ESC D**

Causes the current line to be printed, and then advances the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: LF
Hexadecimal: 0A

Control code: IND
Hexadecimal: 84

Escape Sequence: ESC D
Hexadecimal: 1B 44

Partial Line Down **PLD**
(or) **ESC K**

Performs a half line feed. Causes the current line to be printed, and then advances the paper one half line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: PLD
Hexadecimal: 8B

Escape Sequence: ESC K
Hexadecimal: 1B 4B

Partial Line Up **PLU**
(or) **ESC L**

Performs a reverse half line feed. Causes the current line to be printed, and then retracts the paper one half line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: PLU
Hexadecimal: 8C

Escape Sequence: ESC L
Hexadecimal: 1B 4C

Absolute Vertical Tab **ESC [*n* d**

Sets the current line to line *n* of the current form. The actual position will depend on the current line spacing.

Example: The following escape sequence will set the active line to line 12.

Escape Sequence:	ESC	[	1	2	d
Hexadecimal:	1B	5B	31	32	64

Relative Vertical Tab **ESC [*n* e**

Advances the active line by *n* lines. The actual distance moved will depend on the current line spacing. Equivalent to sending *n* line feeds (LF).

Example: The following escape sequence will advance the active line by 12 lines. If current line spacing is 6 lpi, this will cause the paper to advance one inch.

Escape Sequence:	ESC	[	1	2	e
Hexadecimal:	1B	5B	31	32	65

Horizontal and Vertical Position

New Line **NEL**
(or) **ESC E**

Causes the current line to be printed, and then sets the current print position to the left margin and performs a line feed. Equivalent to a carriage return (CR) line feed (LF) combination.

Control code:	NEL	
Hexadecimal:	85	
Escape Sequence:	ESC	E
Hexadecimal:	1B	45

Form Length and Form Feed

Form length is the distance from the top of the form to the bottom of the form. A form feed will advance the paper to the top of the next form. Some programs do not send form feeds. Instead, they count line feeds, and send the appropriate number of line feeds to fill out the page. The usual rational is that the program is then in complete control of form length, and will work on any printer without requiring the correct form length to be set. However, the correct form length should always be set on the FormsPro 4000. Even if the program does not use form feeds, the printer will automatically scroll a completed form up to the tear bar to be torn off. This automatic scroll is based upon form length. The easiest way to set form length is via the "Length:" value in the "Setup: FORM" menu, so it will be correctly set for everyone using the form.

Form Feed **FF**

Causes the current line to be printed, and then advances the paper to the top of the next form. If a top margin is set, printing will continue at the top margin. The "FF at TOF: No" value in the "Setup: INTERFACE" menu allows a form feed to be ignored if the paper is already at top of form. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	FF
Hexadecimal:	0A

Horizontal Tabs

Horizontal tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the tab stops. Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. If different tab stops are to be set, the default tab stops should first be cleared.

Horizontal Tab **HT**

Advances to the next horizontal tab stop. If no tab stop exists between the active column and the right margin, the HT will be ignored. Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. Different tab stops may be set with ESC H, ESC 1, or ESC [*n1* ; *n2* ; ... *nx* u.

Control code:	HT
Hexadecimal:	09

Set Horizontal Tab Stop **HTS**
(or) **ESC H**

Sets a horizontal tab stop at the current print position. The tab stop is associated with the active column, not an absolute physical position. Changing character spacing will change the physical position of the tab stop.

Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. The tab stop set by this escape sequence will be added to previously set tab stops, including the default tab stops. If this is not desired, the old tab stops should first be cleared.

Control code:	HTS
Hexadecimal:	88

Escape Sequence:	ESC	H
Hexadecimal:	1B	48

Clear Horizontal Tab Stop **ESC [g**
(or) **ESC [0 g**

Clears the horizontal tab stop at the current print position. The tab stop to be cleared is associated with the active column (based upon the current character spacing), not an absolute physical position.

Escape Sequence:	ESC	[	g
Hexadecimal:	1B	5B	67

Clear all horizontal tab stops **ESC [2 g**
(or) **ESC [3 g**

Clears all currently set horizontal tab stops.

Escape Sequence:	ESC	[	2	g
Hexadecimal:	1B	5B	32	67

Escape Sequence:	ESC	[	3	g
Hexadecimal:	1B	5B	33	67

Vertical Tabs

Vertical tab stops are associated with lines, not absolute physical positions. Changing line spacing will change the physical position of the tab stops.

Vertical Tab **VT**

Causes the current line to be printed, and then advances the paper to the next vertical tab stop. If no vertical tab stops are set, then a line feed is done instead. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	VT
Hexadecimal:	0B

Set Vertical Tab Stop **VTS**
(or) **ESC J**

Sets a vertical tab stop at the current line. The tab stop is associated with the active line, not an absolute physical position. Changing line spacing will change the physical position of the tab stop.

The tab stop set by this escape sequence will be added to previously set tab stops. If this is not desired, the old tab stops should first be cleared.

Control code:	VTS
Hexadecimal:	8A

Escape Sequence:	ESC	J
Hexadecimal:	1B	4A

Clear Vertical Tab Stop **ESC [1 g**

Clears the vertical tab stop at the current line. The tab stop to be cleared is associated with the active line (based upon the current line spacing), not an absolute physical position.

Escape Sequence:	ESC	[	1	g
Hexadecimal:	1B	5B	31	67

Clear All Vertical Tab Stops **ESC [4 g**

Clears all currently set vertical tab stops.

Escape Sequence:	ESC	[	4	g
Hexadecimal:	1B	5B	34	67

Printer Controls

Bell **BEL**

Causes the printer's bell to sound.

Control code:	BEL
Hexadecimal:	07

Select Automatic Carriage Return **ESC [20 h**

Selects automatic carriage return mode. This causes the printer to automatically perform a carriage return (CR) for each line feed (LF), vertical tab (VT), or form feed (FF) that it receives. Overrides the "Auto CR:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	[	2	0	h
Hexadecimal:	1B	5B	32	30	68

Cancel Automatic Carriage Return **ESC [20 l**

Cancels automatic carriage return mode. Overrides the "Auto CR:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	[	2	0	l
Hexadecimal:	1B	5B	32	30	6C

Reset **ESC c**

Deletes all data on the current line and initializes the printer to the default settings for the current form.

Restores the default horizontal tab stops. Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc.

Resets top of form to the current position, so it is wise to be at top of form before performing this reset. Issuing a form feed will guarantee this.

See the appendix on Printer Reset Conditions for more information.

Escape Sequence:	ESC	c
Hexadecimal:	1B	63

Emulations

Select Software Interface *n* **ESC ESC *n***

Selects the software interface *n* according to the table below.

n	Software Interface
0	Test (reserved for factory use)
1	ANSI X3.64 Emulation
2	Epson FX Emulation
3	Bar Code Mode (optional)
4	IBM Proprinter Emulation
5	DEC LA120 Emulation
6	TTY Emulation
7	Printek Emulation
?	Previously Selected Emulation
@	Default Emulation

Overrides the "Mode:" value in the "Setup: INTERFACE" menu. "Mode: BarberPole" and "Mode: Hex Dump" cannot be overridden.

A numeric value for *n* may be specified in two different ways, with equivalent results: a single byte with a value of 00 to 07 hex, or a single printable ASCII character "0" to "7" (30 to 37 hex).

If more than one emulation has been selected, ESC ESC ? will return to the previously selected emulation. This is particularly useful when the previous emulation is unknown. Please beware that the memory (stack) is only one level deep.

ESC ESC @ will return to the default emulation, as specified by the "Mode:" value in the "Setup: INTERFACE" menu.

This chapter describes ANSI X3.64 emulation. If a different interface is selected, the control codes and escape sequences described in this chapter will no longer be applicable.

Example: The following escape sequences will select Printek emulation, load form one, and then return to the previous emulation.

Escape Sequence:	ESC	ESC	7	ESC	L	1	ESC	ESC	?
Hexadecimal:	1B	1B	07	1B	4C	01	1B	1B	3F

Control Codes and Escape Sequences
Sorted Alphabetically

BEL	Bell
BS	Backspace
CR	Carriage Return
ESC D	Line Feed
ESC E	New Line
ESC ESC *n*	Select Software Interface *n*
ESC H	Set Horizontal Tab Stop
ESC J	Set Vertical Tab Stop
ESC K	Partial Line Down
ESC L	Partial Line Up
ESC [*n1* ; *n2* SP G	Set Character and Line Spacing
ESC [*n* `	Absolute Horizontal Tab
ESC [*n* a	Relative Horizontal Tab
ESC [*n* d	Absolute Vertical Tab
ESC [*n* e	Relative Vertical Tab
ESC [g	Clear Horizontal Tab Stop
ESC [0 g	Clear Horizontal Tab Stop
ESC [1 g	Clear Vertical Tab Stop
ESC [2 g	Clear All Horizontal Tab Stops
ESC [3 g	Clear All Horizontal Tab Stops
ESC [4 g	Clear All Vertical Tab Stops
ESC [20 h	Select Automatic Carriage Return
ESC [20 l	Cancel Automatic Carriage Return
ESC [*n* m	Select Graphic Rendition
ESC c	Reset
ETX	End of Text
FF	Form Feed
HT	Horizontal Tab
HTS	Set Horizontal Tab Stop
IND	Line Feed
LF	Line Feed
NEL	New Line
PLD	Partial Line Down
PLU	Partial Line Up
VT	Vertical Tab
VTS	Set Vertical Tab Stop

EPSON FX EMULATION

Introduction

This section describes the control codes and escape sequences comprising Epson FX emulation. This emulation may be selected by specifying "Mode: Epson" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 2** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

Some escape sequences accept one or more numeric parameters. If a sequence accepts one numeric parameter, it will be represented as "*n*". If a sequence accepts more than one numeric parameter, they will be represented as "*n1 n2 ... nx*".

Since numeric parameters are always encoded in one byte, their values may range from 0 to 255 decimal. Please note that the value will never be represented by a string of ASCII decimal digits ("0" through "9"). For example, a value of 66 decimal would be sent as a single byte with a hex value of 42. This is equivalent to sending the ASCII character "B". It is entirely different than sending the two printable ASCII characters "66".

If a numeric parameter is limited to a value of zero or one, it may be sent as a single byte with a value of 00 or 01 hex (NUL or SOH), or it may be sent as a single printable ASCII character "0" or "1" (30 or 31 hex).

Spaces are used when documenting escape sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*" and "*n1 n2*" above) are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **BS** is the Backspace control code (08 hex), not the two characters "B" and "S" (42 and 53 hex). An ASCII Control Code Table is contained in the appendices for your convenience. If you have any doubt about how to interpret a documented control code or escape sequence, refer to the hex representation in the

provided example. This should clarify any ambiguity. The examples may also be helpful when analyzing a hex dump (see chapter 8) printed by the printer.

Column and line numbers begin at zero, not at one. Keep this in mind when setting tabs, margins, etc.

Control Codes and Escape Sequences Grouped by Function

Communications

Cancel Line **CAN**

Cancels all printable text in the current print line. Does not affect any control codes or escape sequences.

Control code: CAN
Hexadecimal: 18

Delete Character **DEL**

Deletes the last printable character from the current line. Does not affect any control codes or escape sequences.

Control code: DEL
Hexadecimal: 7F

End of Text **ETX**

If "ETX/ACK: On" is specified in the "Setup: INTERFACE" menu, then receipt of an ETX causes the printer to transmit an ACK to the host computer.

Since the ETX may be a legal value within an escape sequence, it is the user's responsibility to ensure that an ETX used for data handshake is not sent within an escape sequence. The user must also ensure that the maximum block size or the number of blocks sent at one time does not exceed the input buffer size of the printer.

ETX/ACK handshake is available only with serial I/O. It is not available when using the parallel interface or the coaxial/twinaxial interface.

If the printing of low symbols is enabled, ETX will be treated as a printable character instead of an I/O handshake control code.

Control code: ETX
Hexadecimal: 03

Set MSB to 0 **ESC =**

Sets the MSB (most significant bit) of all following data to zero. Some computers always set the MSB to one, causing all characters to print in italic mode. This escape sequence can overcome the problem. The problem can also be avoided by selecting "Data Bits: 7" in the "Setup: INTERFACE" menu.

Escape Sequence: ESC =
Hexadecimal: 1B 3D

Set MSB to 1 **ESC >**

Sets the MSB (most significant bit) of all following data to one. This escape sequence allows the eighth bit to be turned on, even if the computer and printer are connected via a 7-bit I/O interface. The eighth bit may be useful for 8-pin graphics data, or for accessing italic characters.

Escape Sequence: ESC >
Hexadecimal: 1B 3E

Cancel MSB Control **ESC #**

Cancels the MSB (most significant bit) control set by ESC = or ESC >. This causes the eighth data bit sent from the host computer to be accepted as is.

Escape Sequence: ESC #
Hexadecimal: 1B 23

Deselect Printer **DC3**
(or) **XOFF**

Deselects the printer. Use of this command is discouraged, because the printer will remain offline until an operator presses the ONLINE button on the control panel.

Control code: DC3
Hexadecimal: 13

Character Size

The FormsPro 4000 is capable of supporting 10, 12, 13.3, 15, 16.7, 17.14, and 20 cpi, but most emulations support only a subset of these. Epson emulation supports 10, 12, 15, 17.14, and 20 cpi via software, but does not support 13.3 or 16.7 cpi. Every emulation supports 10 cpi, and we consider this to be the default character pitch. When you use the control panel to change the "CPI:" value in the "Setup: FORM" menu, you are actually changing the default character pitch. When the printer is turned on (or reset), it will use this character pitch. You can even use a pitch that is not supported by your emulation, such as 13.3 cpi with Epson emulation. You can override this pitch selection via software, by sending an escape sequence. This selects a user specified non-default pitch. For example, in Epson emulation, sending ESC M will select 12 cpi. Sending ESC P will re-select 10 cpi, and thus re-select the default character pitch that was selected in the form setup.

Via software escape sequences, you can select any character pitch supported by the emulation you are using. All will print as expected, unless you select 10 cpi -- because 10 cpi really selects the default character pitch from setup. If you really want 10 cpi, then you must specify "CPI: 10" in the "Setup: FORM" menu. Likewise, if you want to use the default pitch from setup, you must not override it. Either send no character pitch sequences to the printer, or make sure you re-select 10 cpi via software.

When you select different forms, the default character pitch from setup is selected along with the form. But you will not see this default pitch if it has already been overridden via software.

Select 10 CPI **ESC P**

Selects 10 cpi by cancelling 12 cpi and 15 cpi. Condensed mode is unaffected. The resulting character spacing will be 10 cpi, or if condensed mode is also selected, 17.14 cpi.

If "CPI: 10" was not specified in the "Setup: FORM" menu, the specified default character pitch will be selected instead of 10 cpi.

Escape Sequence:	ESC	P
Hexadecimal:	1B	50

Select 12 CPI **ESC M**

Selects 12 cpi (elite mode). Cancels 15 cpi. Condensed mode is unaffected. The resulting character spacing will be 12 cpi, or if condensed mode is also selected, 20 cpi.

Escape Sequence:	ESC	M
Hexadecimal:	1B	4D

Select 15 CPI **ESC g**

Selects 15 cpi. Cancels 12 cpi. Condensed mode is unaffected. The resulting character spacing will be 15 cpi, even if condensed mode is also selected.

Escape Sequence: ESC g
Hexadecimal: 1B 67

Select Condensed Mode **SI**
(or) **ESC SI**

Selects condensed mode. The resulting character spacing will be 17.14 cpi if 10 cpi was selected, or 20 cpi if 12 cpi was selected. If 15 cpi was selected, condensed mode will have no affect.

Control code: SI
Hexadecimal: 0F

Escape Sequence: ESC SI
Hexadecimal: 1B 0F

Cancel Condensed Mode **DC2**

Cancels condensed mode set by SI or ESC SI.

Control code: DC2
Hexadecimal: 12

Select double-wide mode (one line) **SO**
(or) **ESC SO**

Selects double-wide mode for one line. Double-wide mode doubles the width of all characters, but does not affect character height. This mode is cancelled by a carriage return or DC4.

Control code: SO
Hexadecimal: 0E

Escape Sequence: ESC SO
Hexadecimal: 1B 0E

Cancel Double-Wide Mode (one line) **DC4**

Cancels double-wide mode selected by SO or ESC SO. Does not cancel double-wide mode selected by ESC W or ESC !.

Control code: DC4
Hexadecimal: 14

Double-Wide Mode **ESC W *n***

Selects double-wide mode for *n*=1, or cancels for *n*=0. Double-wide mode doubles the width of all characters, but does not affect character height.

Example: The following escape sequence will select double-wide mode.

Escape Sequence:	ESC	W	1
Hexadecimal:	1B	57	31

Double-High Mode **ESC w *n***

Selects double-high mode for *n*=1, or cancels for *n*=0. Double-high mode doubles the height of all characters, but does not affect character width.

Example: The following escape sequence will select double-high mode.

Escape Sequence:	ESC	w	1
Hexadecimal:	1B	77	31

Select Subscript or Superscript Mode **ESC S *n***

Selects subscript mode for *n*=1, or superscript mode for *n*=0. This will print characters about half the normal height, in the bottom or top half of the normal character cell.

Example: The following escape sequence will select superscript mode.

Escape Sequence:	ESC	S	0
Hexadecimal:	1B	53	30

Cancel Subscript and Superscript Mode **ESC T**

Cancels subscript and superscript mode.

Escape Sequence:	ESC	T
Hexadecimal:	1B	54

Character Attributes

Select Emphasized Mode **ESC E**

Selects emphasized mode. This makes characters bolder by printing an extra dot to the right of each dot normally found in the character matrix. This will cut the print speed in half, but will not require an additional pass of the print head. Overrides the "Impact:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	E
Hexadecimal:	1B	45

Cancel Emphasized Mode **ESC F**

Cancels emphasized mode. Overrides the "Impact:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	F
Hexadecimal:	1B	46

Select Double-Strike Mode **ESC G**

Selects double-strike mode. This makes text bolder by printing it twice. This will cut the print speed in half, because an additional pass of the print head will be required.

Escape Sequence:	ESC	G
Hexadecimal:	1B	47

Cancel Double-Strike Mode **ESC H**

Cancels double-strike mode.

Escape Sequence:	ESC	H
Hexadecimal:	1B	48

Underline Mode **ESC - *n***

Selects underline mode for *n*=1, or cancels for *n*=0. This mode provides continuous underlining for all characters, including spaces.

Example: The following escape sequence will turn underlining on.

Escape Sequence:	ESC	-	1
Hexadecimal:	1B	2D	31

Select Italic Mode **ESC 4**

Selects italic mode. This causes italic characters to be printed by setting the MSB (most significant bit) of all following printable characters to one. The effect is to map characters from the bottom half (non-italic) of the font to the top half (italic) of the font. For this to work correctly, an Epson FX font must be selected (see ESC k). The other available fonts do not include italic characters.

Escape Sequence:	ESC	4
Hexadecimal:	1B	34

Cancel Italic Mode **ESC 5**

Cancels italic mode. The MSB (most significant bit) of the following printable characters will be accepted as is. Italic characters may still be printed by transmitting characters with the MSB turned on.

Escape Sequence:	ESC	5
Hexadecimal:	1B	35

Master Print Mode Select **ESC ! *n***

Selects any valid combination of modes from the following table. The value of *n* is determined by adding together the values of the desired modes from the table.

n	Attribute
0	10 cpi
1	12 cpi
4	Condensed
8	Emphasized
16	Double-Strike
32	Double-Wide
64	Italic
128	Underline

Example: The following escape sequence will select 12 cpi condensed, resulting in 20 cpi character spacing.

Escape Sequence:	ESC	!	5
Hexadecimal:	1B	21	05

Example: The following escape sequence will select emphasized, double-wide, and underline, for a heading that really stands out.

Escape Sequence:	ESC	!	168
Hexadecimal:	1B	21	A8

Character Sets

Select Draft or Letter Quality **ESC x *n***

Selects draft for *n*=0 or letter quality for *n*=1. Same as ESC k 0 or ESC k 1. Overrides the "Font:" value in the "Setup: FORM" menu.

Example: The following escape sequence will select draft print.

Escape Sequence:	ESC	x	0
Hexadecimal:	1B	78	30

Select Font **ESC k *n***

Select font *n* according to the following table.

n	Font
0	Epson FX Draft
1	Epson FX Letter Quality
2	Proprinter Draft
3	Proprinter Letter Quality
10	EBCDIC Draft (optional)
11	EBCDIC Letter Quality (optional)
12	OCR-A Optical Quality (optional)
13	OCR-B Optical Quality (optional)
32	Epson FX Fast Draft
33	Epson FX Draft
34	Epson FX Letter Quality
36	Proprinter PC Fast Draft
37	Proprinter PC Draft
38	Proprinter PC Letter Quality
44	PC Latin II (Slavic) Fast Draft
45	PC Latin II (Slavic) Draft
46	PC Latin II (Slavic) Letter Quality
64	EBCDIC Fast Draft
65	EBCDIC Draft
66	EBCDIC Letter Quality
71	OCR-A Optical Quality
75	OCR-B Optical Quality

Overrides the "Font:" value in the "Setup: FORM" menu. If the specified font is not installed, the "Font:" value in the "Setup: FORM" menu will be used to select the default font.

Example: The following escape sequence will select the Epson FX letter quality font.

Escape Sequence:	ESC	k	1
Hexadecimal:	1B	6B	01

Select International Character Set **ESC R *n***

Selects the international character set as specified by the value of *n* in the following table. Overrides the "Lang:" value in the "Setup: FORM" menu.

n	Character Set
0	United States of America
1	France
2	Germany
3	United Kingdom
4	Denmark
5	Sweden
6	Italy
7	Spain
8	Japan

The actual character substitutions are shown in the "International Character Mapping" table below. For this to work correctly, an Epson FX font must be selected (see ESC k).

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	$	@	[	\	]	^	`	{	¦	}	~
France	#	$	à	°	ç	§	^	`	é	ù	è	¨
Germany	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
England	£	$	@	[	\	]	^	`	{	¦	}	~
Denmark	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
Sweden	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
Italy	#	$	@	°	\	é	^	ù	à	ò	è	ì
Spain	P_{TS}	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
Japan	#	$	@	[	¥	]	^	`	{	¦	}	~

Example: The following escape sequence will select the German character set.

Escape Sequence:	ESC	R	2
Hexadecimal:	1B	52	02

Character Table **ESC t *n***

Selects the Epson italic character set or the Epson extended graphics character set. As implemented, this selects either the Epson FX font or the PC USA font. The character attribute (fast draft, draft, or letter quality) will not change.

Example: The following escape sequence will select the Epson FX font.

Escape Sequence:	ESC	t	0
Hexadecimal:	1B	74	30

Enable Printing of High Symbols **ESC 6**

Enables printing of character values 128 through 159 decimal. If printing is not enabled, these characters will be treated as control codes. Overrides the "Chars:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	6
Hexadecimal:	1B	36

Disable Printing of High Symbols **ESC 7**

Disables printing of character values 128 through 159 decimal. These characters will be treated as control codes. Overrides the "Chars:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	7
Hexadecimal:	1B	37

Printing of Low Symbols **ESC I *n***

Enables printing of character values 0 through 31 decimal if they are not used as control codes for *n*=1, or disables printing for *n*=0. Overrides the "Chars:" value in the "Setup: INTERFACE" menu.

Example: The following escape sequence will disable printing of character values 0 through 31 decimal.

Escape Sequence:	ESC	I	0
Hexadecimal:	1B	49	30

Line Pitch

Select 8 LPI **ESC 0**

Sets the line spacing to 1/8 of an inch per line (8 lpi). Overrides the "LPI:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	0
Hexadecimal:	1B	30

Set Line Spacing to 7/72" **ESC 1**

Sets the line spacing to 7/72 of an inch per line. Since the distance between print head wires is 1/72 of an inch, this is equivalent to setting seven wire spacing. This is not particularly useful for text, but may be useful for graphics if 7-bit graphics data is being sent. Overrides the "LPI:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	1
Hexadecimal:	1B	31

Select 6 LPI **ESC 2**

Sets the line spacing to 1/6 of an inch per line (6 lpi). This is the normal text line spacing. Overrides the "LPI:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	2
Hexadecimal:	1B	32

Set Line Spacing to *n*/216" **ESC 3 *n***

Sets the line spacing to *n*/216 of an inch per line. $0 \geq n \geq 255$. Overrides the "LPI:" value in the "Setup: FORM" menu.

NOTE: The actual resolution of the FormsPro 4000 paper stepper motor is 1/288 of an inch. When spacing is specified in 1/216 of an inch, the printer will actually move paper to the nearest 1/288 of an inch.

Example: The following escape sequence will set line spacing to one half inch.

Escape Sequence:	ESC	3	108
Hexadecimal:	1B	33	6C

Set Line Spacing to *n*/72" **ESC A *n***

Sets the line spacing to *n*/72 of an inch per line. 0≥*n*≥255. Since the distance between print head wires is 1/72 of an inch, this is equivalent to setting *n* wire spacing. Overrides the "LPI:" value in the "Setup: FORM" menu.

Example: The following escape sequence will set line spacing to 8/72 of an inch, for use with eight wire graphics.

Escape Sequence:	ESC	A	8
Hexadecimal:	1B	41	08

Horizontal Position

Carriage Return **CR**

Causes the current line to be printed, and then sets the current print position to the left margin. If "Auto LF: On" is selected in the "Setup: INTERFACE" menu, a line feed will also be performed.

Control code:	CR
Hexadecimal:	0D

Backspace **BS**

Causes the current line to be printed, and then moves the current print position one space to the left. The actual distance moved depends on the current character spacing. Backspacing can be done up to, but not beyond, the left margin.

Control code:	BS
Hexadecimal:	08

Vertical Position

Line Feed — LF

Causes the current line to be printed, and then advances the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	LF
Hexadecimal:	0A

Variable Distance Line Feed — ESC J *n*

Causes the current line to be printed, and then performs a single line feed of *n*/216ths of an inch. $0 \geq n \geq 255$. Does not change the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Example: The following escape sequence will advance the paper one half inch.

Escape Sequence:	ESC	J	108
Hexadecimal:	1B	4A	6C

Variable Distance Reverse Line Feed — ESC j *n*

Performs a single reverse line feed of *n*/216ths of an inch. $0 \geq n \geq 255$. Does not change the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Example: The following escape sequence will move the paper down one half inch.

Escape Sequence:	ESC	j	108
Hexadecimal:	1B	6A	6C

Form Length and Form Feed

Form length is the distance from the top of the form to the bottom of the form. Form length may be specified either in inches, or in lines. A form feed will advance the paper to the top of the next form. Some programs do not send form feeds. Instead, they count line feeds, and send the appropriate number of line feeds to fill out the page. The usual rational is that the program is then in complete control of form length, and will work on any printer without requiring the correct form length to be set. However, the correct form length should always be set on the FormsPro 4000. Even if the program does not use form feeds, the printer will automatically scroll a completed form up to the tear bar to be torn off. This automatic scroll is based upon form length. The easiest way to set form length is via the "Length:" value in the "Setup: FORM" menu, so it will be correctly set for everyone using the form. If correct form length cannot be guaranteed from SETUP, then each program should set the correct form length.

Set Form Length in Lines **ESC C *n***

Sets the form length to *n* lines at the current line spacing. $1 \le n \le 255$. Maximum form length is 37.9 inches. Invalid form lengths will be ignored. Overrides the "Length:" value in the "Setup: FORM" menu.

For example, an 11 inch form contains 66 lines at 6 LPI, but 88 lines at 8 LPI. If line spacing is changed after setting the form length, the physical form length (in inches) will not be changed.

Resets top of form to the current position, so it is wise to be at top of form before setting form length. Issuing a form feed will guarantee this. Vertical margins are cleared.

Example: The following escape sequence will set form length to 66 lines. At 6 LPI, this will result in a form length of 11 inches.

Escape sequence:	ESC	C	66
Hexadecimal:	1B	43	42

Set Form Length in Inches **ESC C NUL *n***

Sets the form length to *n* inches. $1 \le n \le 37$. Maximum form length is 37.9 inches. Invalid form lengths will be ignored. Overrides the "Length:" value in the "Setup: FORM" menu.

Resets top of form to the current position, so it is wise to be at top of form before setting form length. Issuing a form feed will guarantee this. Vertical margins are cleared.

Example: The following escape sequence will set form length to 11 inches, regardless of what line spacing is set.

Escape sequence:	ESC	C	NUL	11
Hexadecimal:	1B	43	00	0B

Form Feed **FF**

Causes the current line to be printed, and then advances the paper to the top of the next form. If a top margin is set, printing will continue at the top margin. The "FF at TOF: No" value in the "Setup: INTERFACE" menu allows a form feed to be ignored if the paper is already at top of form. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	FF
Hexadecimal:	0A

Horizontal Tabs

Default horizontal tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. The default tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the default tab stops.

User defined horizontal tab stops are associated with absolute physical positions, not with columns. The tab stops are set relative to the current character spacing, but subsequent changes in character spacing will not affect the physical position of the tab stops (except that the position will be rounded up to the closest character boundary).

Horizontal Tab **HT**

Advances to the next horizontal tab stop. If no tab stop exists between the active column and the right margin, the HT will be ignored. Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. Different tab stops may be set with ESC D.

Control code:	HT
Hexadecimal:	09

Absolute Horizontal Tab **ESC $ *n1 n2***

Move to the specified carriage position. The position is specified in 60ths of an inch, and calculated as $\frac{n1+(n2\times 256)}{60}$ inches. The position is relative to the left margin and must not exceed the right margin or it will be ignored.

Example: The following escape sequence will set the carriage position 5 inches (300/60 inches) from the left margin.

Escape Sequence:	ESC	$	44	1
Hexadecimal:	1B	24	2C	01

Relative Horizontal Tab **ESC \ *n1 n2***

Move the carriage position to the left or right of the current carriage position. The displacement is specified in 120ths of an inch, and calculated as $\frac{n1+(n2\times 256)}{120}$ inches. The new position is relative to the current carriage position, and must fall within the left and right margins or it will be ignored. A negative displacement (2's complement) causes a move to the left.

Example: The following escape sequence will move the carriage one inch to the right.

Escape Sequence:	ESC	\	120	0
Hexadecimal:	1B	5C	78	00

Example: The following escape sequence will move the carriage one inch to the left.

Escape Sequence:	ESC	\	136	255
Hexadecimal:	1B	5C	88	FF

Set Horizontal Tab Stops **ESC D *n1 n2 ... nx* NUL**

Clears all currently set horizontal tab stops, and sets new tab stops at column *n1*, *n2*, *n3*, etc. $1 \le n \le 255$. The tab stops must be presented in ascending order. The NUL character, or any tab stop value less than the preceding one, terminates the sequence. The tab stops are set relative to the current character spacing, but subsequent changes in character spacing will not affect the physical position of the tab stops (except that the position will be rounded up to the closest character boundary). The leftmost column is column zero.

Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. The tab stops set by ESC D will replace the default tab stops. ESC D NUL will clear all tab stops, leaving no tab stops set. The default tab stops are restored by ESC @.

Example: The following escape sequence will set horizontal tab stops at half inch intervals, if character spacing is currently 10 cpi.

Escape Sequence:	ESC	D	5	10	15	20	25	30	NUL
Hexadecimal:	1B	44	05	0A	0f	14	19	1E	00

Vertical Tabs

Vertical tab stops are associated with absolute physical positions, not with lines. The tab stops are set relative to the current line spacing, but subsequent changes in line spacing will not affect the physical position of the tab stops.

Vertical Tab **VT**

Causes the current line to be printed, and then advances the paper to the next vertical tab stop. If no vertical tab stops are set, then a line feed is done instead. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	VT
Hexadecimal:	0B

Set Vertical Tab Stops **ESC B *n1 n2 ... nx* NUL**

Clears all currently set vertical tab stops, and sets new tab stops at line *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops must be presented in ascending order. The NUL character, or any tab stop value less than the preceding one, terminates the sequence. The tab stop settings are based on the current line spacing. Changing the line spacing after the tab stops are set will not affect the position of the tab stops. The first line is line zero.

ESC B NUL will clear all currently set vertical tab stops, leaving no vertical tab stops set.

Example: The following escape sequence will set vertical tab stops at line 6, 12, and 24. If line spacing is currently 6 lpi, this will result in tab stops one inch, two inches, and four inches from the top of the form.

Escape Sequence:	ESC	B	6	12	24	NUL
Hexadecimal:	1B	42	06	0C	18	00

Horizontal Margins

Printing is allowed only within the left and right margins. Exceeding the right margin will cause line wrap, setting the current print position to the left margin and advancing the paper one line.

Set Left Margin **ESC l *n***

Sets the left margin to column *n* at the current character spacing. If character spacing is changed after setting the left margin, the position of the left margin will not change.

The left margin is inclusive. For example, a left margin at column 10 still allows a character to be printed in column 10.

The leftmost column is column zero. The left margin must be left of the right margin and ≥13.4 inches. Invalid left margins will be ignored. Overrides the "Left Mar:" value in the "Setup: FORM" menu.

Example: The following escape sequence will set a one inch left margin, if character spacing is currently 10 cpi.

Escape Sequence:	ESC	l	10
Hexadecimal:	1B	6C	0A

Set Right Margin **ESC Q *n***

Sets the right margin to column *n* at the current character spacing. If character spacing is changed after setting the right margin, the position of the right margin will not change.

The right margin is exclusive. For example, a right margin at column 75 allows a character to be printed in column 74, but not in column 75.

The leftmost column is column zero. The right margin must be right of the left margin and ≤13.6 inches. Invalid right margins will be ignored. Overrides the "Right Mar:" value in the "Setup: FORM" menu.

Example: The following escape sequence will set a right margin 7.5 inches from the left edge of the form, if character spacing is currently 10 cpi. For a standard 8.5 inch wide form, this would result in a one inch right margin.

Escape Sequence:	ESC	Q	75
Hexadecimal:	1B	51	4B

Vertical Margins

Printing is allowed only within the top and bottom margins. Exceeding the bottom margin will set the current line to the top margin of the next form.

Set Perforation Skip **ESC N *n***

Sets the perforation skip distance to *n* lines at the current line spacing. $1 \geq n \geq 255$. If line spacing is changed after setting the skip distance, the skip distance will not be changed.

The skip distance is split between the top and bottom margins, so the perforation will be centered in the resulting white space. The specified skip distance must be less than the form length, or the command will be ignored. Perforation skip is canceled by ESC O, ESC C *n* or ESC C NUL *n*. Overrides the "Top Mar:" and "Btm Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a two inch perforation skip distance, if the current line spacing is 6 lpi. This will result in a one inch top and bottom margin.

Escape Sequence:	ESC	N	12
Hexadecimal:	1B	4E	0C

Cancel Perforation Skip **ESC O**

Cancels perforation skip. This is equivalent to having no top and bottom margin. Overrides the "Top Mar:" and "Btm Mar:" values in the "Setup: FORM" menu.

Escape Sequence:	ESC	O
Hexadecimal:	1B	4F

Graphics

Graphics mode gives the user complete control over every dot position on the paper. Graphics may be printed with various horizontal densities from 60 to 240 dpi, and a vertical density of 72 dpi.

Each byte of graphics data represents a vertical column of eight dots, with the MSB (most significant bit) corresponding to the top wire of the print head. Turning a bit on causes a dot to be printed. The bit values corresponding to each wire of the print head are shown below:

wire 1	128	(80 hex)
wire 2	64	(40 hex)
wire 3	32	(20 hex)
wire 4	16	(10 hex)
wire 5	8	(08 hex)
wire 6	4	(04 hex)
wire 7	2	(02 hex)
wire 8	1	(01 hex)

The appropriate bit values are added together to fire the desired wires. For example, a byte of graphics data with the value 128 (80 hex) will fire the top wire, wire 1. A value of 192 (C0 hex) will fire the top two wires, wires 1 and 2. A value of 11 (0B hex) will fire wires 5, 7 and 8.

Each graphics sequence contains two bytes (*n1* and *n2*) that specify how many bytes of graphics data follow. The first byte, *n1*, can specify values up to 255. If that is sufficient, then *n2* is set to zero. For values greater than 255, *n2* comes into play. The *n2* byte specifies multiples of 256. For example, to specify 520 bytes of graphics data, *n1* = 8 and *n2* = 2. The bytes of graphics data are strung together to create a graphics line that is eight dots high, and *n1* + (*n2* x 256) dots long. Be sure to provide the amount of graphics data that you specify, because the printer will not leave graphics mode until it has accepted the specified number of data bytes.

If "Data Bits: 7" is specified in the "Setup: INTERFACE" menu, beware of potential problems in graphics mode. Since the MSB (most significant bit) will always be turned off, it will not be possible to fire the top wire of the print head. Worse yet, the value of *n1* or *n2* may be changed. For example, if *n1* specifies 200 bytes of data, and its MSB is turned off, the printer will only expect 72 bytes of data. It will exit graphics mode, and then try to print the remaining 128 bytes of graphics data as normal text characters. The result will surely not be pretty. To avoid such problems, the use of an 8-bit I/O interface for printing graphics is highly recommended.

The normal graphics modes allow every dot to be printed. High speed graphics will print twice as fast, but will not allow consecutive dots to be printed.

60 DPI Graphics **ESC K *n1 n2 data***

Selects eight wire single density (60 dpi) graphics for *n1* + (*n2* x 256) columns of data.

Example: The following escape sequence will print six bytes of graphics data at 60 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	K	6	0	128	64	32	16	8	4
Hexadecimal:	1B	4B	06	00	80	40	20	10	08	04

120 DPI Graphics **ESC L *n1 n2 data***

Selects eight wire double density (120 dpi) graphics for *n1* + (*n2* x 256) columns data.

Example: The following escape sequence will print six bytes of graphics data at 120 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	L	6	0	128	64	32	16	8	4
Hexadecimal:	1B	4C	06	00	80	40	20	10	08	04

High Speed 120 DPI Graphics **ESC Y *n1 n2 data***

Selects eight wire high speed double density (120 dpi) graphics for *n1* + (*n2* x 256) columns of data. Horizontally adjacent dots may not be printed.

Example: The following escape sequence will print six bytes of graphics data at 120 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	Y	6	0	128	64	32	16	8	4
Hexadecimal:	1B	59	06	00	80	40	20	10	08	04

High Speed 240 DPI Graphics **ESC Z *n1 n2 data***

Selects eight wire quadruple density (240 dpi) graphics for *n1* + (*n2* x 256) columns of data. Horizontally adjacent dots may not be printed.

Example: The following escape sequence will print six bytes of graphics data at 240 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	Z	6	0	128	64	32	16	8	4
Hexadecimal:	1B	5A	06	00	80	40	20	10	08	04

m DPI Graphics — ESC * *m n1 n2 data*

Selects eight wire graphics of density *m* as listed in the following table for *n1* + (*n2* x 256) columns of data.

m	Density
0	60 dpi (same as ESC K)
1	120 dpi (same as ESC L)
2	120 dpi high speed (same as ESC Y)
3	240 dpi high speed (same as ESC Z)
4	80 dpi
5	72 dpi
6	90 dpi
7	144 dpi

Example: The following escape sequence will print four bytes of graphics data at 72 x 72 dpi. The resulting figure will resemble a square, since the horizontal and vertical density are the same. If some other density is chosen, the figure will resemble a rectangle.

Escape Sequence:	ESC	*	5	4	0	<	<	<	<
Hexadecimal:	1B	2A	05	04	00	3C	3C	3C	3C

Printer Controls

Bell **BEL**

Causes the printer's bell to sound.

Control code: BEL
Hexadecimal: 07

Unidirectional Mode (one line) **ESC <**

Selects unidirectional mode for the current line (until a carriage return is received). This will force the line to print from left to right.

Escape Sequence: ESC <
Hexadecimal: 1B 3C

Unidirectional Mode **ESC U *n***

Selects unidirectional mode for *n*=1, or bidirectional mode for *n*=0. Printing is normally bidirectional. Unidirectional printing provides more accurate positioning, but causes lower throughput.

Example: The following escape sequence will force unidirectional printing.

Escape Sequence: ESC U 1
Hexadecimal: 1B 55 31

Reset **ESC @**

Deletes all data on the current line and initializes the printer to the default settings for the current form.

Restores the default horizontal tab stops. Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc.

Resets top of form to the current position, so it is wise to be at top of form before performing this reset. Issuing a form feed will guarantee this.

See the appendix on Printer Reset Conditions for more information.

Escape Sequence: ESC @
Hexadecimal: 1B 40

Forms and Tractors

The FormsPro 4503 contains three sets of paper tractors (front, center, and rear). It is possible, via software, to change to a different set of tractors and continue printing.

You may change to a different set of tractors by selecting a different form. The "Path:" value in the "Setup: FORM" menu specifies "Front", "Center", or "Rear" for each form that is defined. When a form is selected, the associated set of tractors is also automatically selected.

Load Form **ESC EM *n***

Causes the current line to be printed, and then loads paper and form parameters for form *n*. $0 \geq n \geq 2$. If form *n* is already loaded, this sequence is ignored. If not, the current form will be unloaded, the parameters for form *n* will be selected, and the printer will go offline to wait for the operator to install the new form and place the printer back online. In the FormsPro 4503 the same happens unless selecting form *n* also selects a different paper path. In that case, the current form is unloaded, the tractors are moved to engage the new path, the new form is loaded, and printing may continue.

The printer will not unload the current form if a previously printed form has not been torn off. In this case, the printer will go offline, sound the bell, and display the message "Tear Off Paper". When an operator tears off the paper and places the printer back online, the printer will unload the current form and continue.

If the printer is unable to load the new form, it will sound the bell and display the message "No Paper to Load". A "Paper Out" error will occur and the printer will go offline to wait for an operator to clear the error.

Example: The following escape sequence will load form 2.

Escape Sequence:	ESC	EM	2
Hexadecimal:	1B	19	32

Emulations

Select Software Interface *n* **ESC ESC *n***

Selects the software interface *n* according to the table below.

n	Software Interface
0	Test (reserved for factory use)
1	ANSI X3.64 Emulation
2	Epson FX Emulation
3	Bar Code Mode (optional)
4	IBM Proprinter Emulation
5	DEC LA120 Emulation
6	TTY Emulation
7	Printek Emulation
?	Previously Selected Emulation
@	Default Emulation

Overrides the "Mode:" value in the "Setup: INTERFACE" menu. "Mode: BarberPole" and "Mode: Hex Dump" cannot be overridden.

A numeric value for *n* may be specified in two different ways, with equivalent results: a single byte with a value of 00 to 07 hex, or a single printable ASCII character "0" to "7" (30 to 37 hex).

If more than one emulation has been selected, ESC ESC ? will return to the previously selected emulation. This is particularly useful when the previous emulation is unknown. Please beware that the memory (stack) is only one level deep.

ESC ESC @ will return to the default emulation, as specified by the "Mode:" value in the "Setup: INTERFACE" menu.

This chapter describes Epson FX emulation. If a different interface is selected, the control codes and escape sequences described in this chapter will no longer be applicable.

Example: The following escape sequences will select Printek emulation, load form one, and then return to the previous emulation.

Escape Sequence:	ESC	ESC	7	ESC	L	1	ESC	ESC	?
Hexadecimal:	1B	1B	07	1B	4C	01	1B	1B	3F

Control Codes and Escape Sequences
Sorted Alphabetically

BEL	Bell
BS	Backspace
CAN	Cancel Line
CR	Carriage Return
DC2	Cancel Condensed Mode
DC3	Deselect Printer
DC4	Cancel Double-Wide Mode (one line)
DEL	Delete Character
ESC ! *n*	Master Print Mode Select
ESC #	Cancel MSB Control
ESC * *m n1 n2 data*	*m* DPI Graphics
ESC - *n*	Underline Mode
ESC 0	Select 8 LPI
ESC 1	Set Line Spacing to 7/72"
ESC 2	Select 6 LPI
ESC 3 *n*	Set Line Spacing to *n*/216"
ESC 4	Select Italic Mode
ESC 5	Cancel Italic Mode
ESC 6	Enable Printing of High Symbols
ESC 7	Disable Printing of High Symbols
ESC <	Unidirectional Mode (one line)
ESC =	Set MSB to 0
ESC >	Set MSB to 1
ESC @	Reset
ESC A *n*	Set Line Spacing to *n*/72"
ESC B *n1 n2 ... nx* NUL	Set Vertical Tab Stops
ESC C NUL *n*	Set Form Length in Inches
ESC C *n*	Set Form Length in Lines
ESC D *n1 n2 ... nx* NUL	Set Horizontal Tab Stops
ESC E	Select Emphasized Mode
ESC EM *n*	Load Form
ESC ESC *n*	Select Software Interface *n*
ESC F	Cancel Emphasized Mode
ESC G	Select Double-Strike Mode
ESC H	Cancel Double-Strike Mode
ESC I *n*	Printing of Low Symbols
ESC J *n*	Variable Distance Line Feed
ESC K *n1 n2 data*	60 DPI Graphics
ESC L *n1 n2 data*	120 DPI Graphics
ESC M	Select 12 CPI

ESC N *n*	Set Perforation Skip
ESC O	Cancel Perforation Skip
ESC P	Select 10 CPI
ESC Q *n*	Set Right Margin
ESC R *n*	Select International Character Set
ESC S *n*	Select Subscript or Superscript Mode
ESC SI	Select Condensed Mode
ESC SO	Select Double-Wide Mode (one line)
ESC T	Cancel Subscript and Superscript Mode
ESC U *n*	Unidirectional Mode
ESC W *n*	Double-Wide Mode
ESC Y *n1 n2 data*	High Speed 120 DPI Graphics
ESC Z *n1 n2 data*	High Speed 240 DPI Graphics
ESC g	Select 15 CPI
ESC j *n*	Variable Distance Reverse Line Feed
ESC k *n*	Select Font
ESC l *n*	Set Left Margin
ESC w *n*	Double-High Mode
ESC x *n*	Select Draft or Letter Quality
ETX	End of Text
FF	Form Feed
HT	Horizontal Tab
LF	Line Feed
SI	Select Condensed Mode
SO	Select Double-Wide Mode (one line)
VT	Vertical Tab
XOFF	Deselect Printer

IBM PROPRINTER EMULATION

Introduction

This section describes the control codes and escape sequences comprising IBM Proprinter emulation. This emulation may be selected by specifying "Mode: Proprinter" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 4** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

Some escape sequences accept one or more numeric parameters. If a sequence accepts one numeric parameter, it will be represented as "*n*". If a sequence accepts more than one numeric parameter, they will be represented as "*n1 n2 ... nx*".

Since numeric parameters are always encoded in one byte, their values may range from 0 to 255 decimal. Please note that the value will never be represented by a string of ASCII decimal digits ("0" through "9"). For example, a value of 66 decimal would be sent as a single byte with a hex value of 42. This is equivalent to sending the ASCII character "B". It is entirely different than sending the two printable ASCII characters "66".

If a numeric parameter is limited to a value of zero or one, it may be sent as a single byte with a value of 00 or 01 hex (NUL or SOH), or it may be sent as a single printable ASCII character "0" or "1" (30 or 31 hex).

Spaces are used when documenting escape sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*" and "*n1 n2*" above) are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **BS** is the Backspace control code (08 hex), not the two characters "B" and "S" (42 and 53 hex). An ASCII Control Code Table is contained in the appendices for your convenience. If you have any doubt about how to interpret a documented control code or escape sequence, refer to the hex representation in the

provided example. This should clarify any ambiguity. The examples may also be helpful when analyzing a hex dump (see chapter 8) printed by the printer.

Column and line numbers begin at one, not at zero. Keep this in mind when setting tabs, margins, etc.

Control Codes and Escape Sequences Grouped by Function

Communications

Cancel Line **CAN**

Cancels all printable text in the current print line. Does not affect any control codes or escape sequences.

Control code:	CAN
Hexadecimal:	18

End of Text **ETX**

If "ETX/ACK: On" is specified in the "Setup: INTERFACE" menu, then receipt of an ETX causes the printer to transmit an ACK to the host computer.

Since the ETX may be a legal value within an escape sequence, it is the user's responsibility to ensure that an ETX used for data handshake is not sent within an escape sequence. The user must also ensure that the maximum block size or the number of blocks sent at one time does not exceed the input buffer size of the printer.

ETX/ACK handshake is available only with serial I/O. It is not available when using the parallel interface or the coaxial/twinaxial interface.

If character set 2 is selected, ETX will be treated as a printable character instead of an I/O handshake control code.

Control code:	ETX
Hexadecimal:	03

Deselect Printer **ESC Q *n***

Deselects the printer. Use of this command is discouraged, because the printer will remain offline until an operator presses the ONLINE button on the control panel.

For a Proprinter II or Proprinter III, *n* should be 3. For a Proprinter XL or Proprinter III XL, *n* should be 22. It does not really matter, because *n* will be ignored.

Example: The following escape sequence will force the printer offline.

Escape Sequence:	ESC	Q	22
Hexadecimal:	1B	51	16

Character Size

The FormsPro 4000 is capable of supporting 10, 12, 13.3, 15, 16.7, 17.14, and 20 cpi, but most emulations support only a subset of these. IBM Proprinter emulation supports 10, 12, 17.14, and 20 cpi via software, but does not support 13.3, 15 or 16.7 cpi. Every emulation supports 10 cpi, and we consider this to be the default character pitch. When you use the control panel to change the "CPI:" value in the "Setup: FORM" menu, you are actually changing the default character pitch. When the printer is turned on (or reset), it will use this character pitch. You can even use a pitch that is not supported by your emulation, such as 13.3 cpi with IBM Proprinter emulation. You can override this pitch selection via software, by sending an escape sequence. This selects a user specified non-default pitch. For example, in IBM Proprinter emulation, sending ESC : will select 12 cpi. Sending DC2 will re-select 10 cpi, and thus re-select the default character pitch that was selected in the form setup.

Via software escape sequences, you can select any character pitch supported by the emulation you are using. All will print as expected, unless you select 10 cpi -- because 10 cpi really selects the default character pitch from setup. If you really want 10 cpi, then you must specify "CPI: 10" in the "Setup: FORM" menu. Likewise, if you want to use the default pitch from setup, you must not override it. Either send no character pitch sequences to the printer, or make sure you re-select 10 cpi via software.

When you select different forms, the default character pitch from setup is selected along with the form. But you will not see this default pitch if it has already been overridden via software.

Select 10 CPI **DC2**

Selects 10 cpi by cancelling 12 cpi and condensed mode. If "CPI: 10" was not specified in the "Setup: FORM" menu, the specified default character pitch will be selected instead of 10 cpi.

Control code: DC2
Hexadecimal: 12

Select 12 CPI **ESC :**

Selects 12 cpi (elite mode). Condensed mode is unaffected. The resulting character spacing will be 12 cpi, or if condensed mode is also selected, 20 cpi.

Escape Sequence: ESC :
Hexadecimal: 1B 3A

Select Condensed Mode **SI**
(or) **ESC SI**

Selects condensed mode. The resulting character spacing will be 17.14 cpi if 10 cpi was selected, or 20 cpi if 12 cpi was selected.

Control code:	SI	
Hexadecimal:	0F	
Escape Sequence:	ESC	SI
Hexadecimal:	1B	0F

Select Double-Wide Mode (one line) **SO**
(or) **ESC SO**

Selects double-wide mode for one line. Double-wide mode doubles the width of all characters, but does not affect character height. This mode is cancelled by a carriage return or DC4.

Control code:	SO	
Hexadecimal:	0E	
Escape Sequence:	ESC	SO
Hexadecimal:	1B	0E

Cancel Double-Wide Mode (one line) **DC4**

Cancels double-wide mode selected by SO or ESC SO. Does not cancel double-wide mode selected by ESC W or ESC !.

Control code:	DC4
Hexadecimal:	14

Double-Wide Mode **ESC W *n***

Selects double-wide mode for *n*=1, or cancels for *n*=0. Double-wide mode doubles the width of all characters, but does not affect character height.

Example: The following escape sequence will select double-wide mode.

Escape Sequence:	ESC	W	1
Hexadecimal:	1B	57	31

Double-High Mode **ESC [@ *n1 n2 m1 m2 m3 m4***

Selects single or double-high mode, single or double-wide mode, and single or double line feeds.

The two bytes *n1* and *n2* specify how many mode bytes (*m1*, *m2*, *m3*, *m4*) follow. Theoretically, there may be *n1* + (*n2* x 256) mode bytes. Actually, *n2* must be 0, and *n1* may be 0 to 4, but is normally 4.

m1 and *m2* must be 0 (NUL). *m3* and *m4* may be set to the values in the following tables.

m3	hex	character height and line spacing
0	00	no change
1	01	line feeds unchanged, single-high characters
2	02	line feeds unchanged, double-high characters
16	10	single line feeds, character height unchanged
17	11	single line feeds, single-high characters
18	12	single line feeds, double-high characters
32	20	double line feeds, character height unchanged
33	21	double line feeds, single-high characters
34	22	double line feeds, double-high characters

m4	hex	character width
1	01	single-wide characters
2	02	double-wide characters

Example: The following escape sequence will select double-wide and double-high mode, with double line feeds.

Escape Sequence:	ESC	[	@	4	0	0	0	34	2
Hexadecimal:	1B	5B	40	04	00	00	00	22	02

Select Subscript or Superscript Mode **ESC S *n***

Selects subscript mode for *n*=1, or superscript mode for *n*=0. This will print characters about half the normal height, in the bottom or top half of the normal character cell.

Example: The following escape sequence will select superscript mode.

Escape Sequence:	ESC	S	0
Hexadecimal:	1B	53	30

Cancel Subscript and Superscript Mode **ESC T**

Cancels subscript and superscript mode.

Escape Sequence:	ESC	T
Hexadecimal:	1B	54

Character Attributes

Select Emphasized Mode **ESC E**

Selects emphasized mode. This makes characters bolder by printing an extra dot to the right of each dot normally found in the character matrix. This will cut the print speed in half, but will not require an additional pass of the print head. Overrides the "Impact:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	E
Hexadecimal:	1B	45

Cancel Emphasized Mode **ESC F**

Cancels emphasized mode. Overrides the "Impact:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	F
Hexadecimal:	1B	46

Select Double-Strike Mode **ESC G**

Selects double-strike mode. This makes text bolder by printing it twice. This will cut the print speed in half, because an additional pass of the print head will be required.

Escape Sequence:	ESC	G
Hexadecimal:	1B	47

Cancel Double-Strike Mode **ESC H**

Cancels double-strike mode.

Escape Sequence:	ESC	H
Hexadecimal:	1B	48

Underline Mode **ESC - *n***

Selects underline mode for *n*=1, or cancels for *n*=0. This mode provides continuous underlining for all characters, including spaces.

Example: The following escape sequence will turn underlining on.

Escape Sequence:	ESC	-	1
Hexadecimal:	1B	2D	31

Character Sets

Select Character Set 1 **ESC 7**

Selects character set 1. Disables printing of character values 0 through 31 decimal, and 128 through 159 decimal, so these characters will be treated as control codes. Overrides the "Chars:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	7
Hexadecimal:	1B	37

Select Character Set 2 **ESC 6**

Selects character set 2. Enables printing of character values 0 through 31 decimal if they are not used as control codes. Enables printing of character values 128 through 159 decimal, so these characters will not be treated as control codes. Overrides the "Chars:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	6
Hexadecimal:	1B	36

Print Single Character **ESC ^ *n***

Prints the character *n* from the all characters chart. This sequence may be used to print a character that is normally treated as a control code.

Example: The following escape sequence will print a left arrow. This character is normally not printable, since it is treated as the ESC control code.

Escape Sequence:	ESC	^	ESC
Hexadecimal:	1B	5E	1B

Print Characters **ESC \ *n1 n2***

Prints the next *n1* + (*n2* x 256) characters from the all characters chart. This sequence may be used to print characters that are normally treated as a control codes.

Example: The following escape sequence will print an up arrow, a down arrow, a right arrow, and a left arrow.

Escape Sequence:	ESC	\	4	0	CAN	EM	SUB	ESC
Hexadecimal:	1B	5C	04	00	18	19	1A	1B

Select Print Mode **ESC I *n***

Selects print mode *n* according to the following chart. Overrides the "Font:" value in the "Setup: FORM" menu.

n	Print Mode
0	Draft
1	Draft 12 cpi
2	Letter Quality
3	Letter Quality

Example: The following escape sequence will select the IBM Proprinter letter quality font.

Escape Sequence:	ESC	I	3
Hexadecimal:	1B	49	03

Line Pitch

Select 8 LPI **ESC 0**

Sets the line spacing to 1/8 of an inch per line (8 lpi). Overrides the "LPI:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	0
Hexadecimal:	1B	30

Set Line Spacing to 7/72" **ESC 1**

Sets the line spacing to 7/72 of an inch per line. Since the distance between print head wires is 1/72 of an inch, this is equivalent to setting seven wire spacing. This is not particularly useful for text, but may be useful for graphics if 7-bit graphics data is being sent. Overrides the "LPI:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	1
Hexadecimal:	1B	31

Start Line Spacing **ESC 2**

Sets the line spacing to the value selected by ESC A *n*. Overrides the "LPI:" value in the "Setup: FORM" menu.

Escape Sequence:	ESC	2
Hexadecimal:	1B	32

Set Line Spacing to *n*/216" **ESC 3 *n***

Sets the line spacing to *n*/216 of an inch per line. 0≥*n*≥255. Overrides the "LPI:" value in the "Setup: FORM" menu.

NOTE: The actual resolution of the FormsPro 4000 paper stepper motor is 1/288 of an inch. When spacing is specified in 1/216 of an inch, the printer will actually move paper to the nearest 1/288 of an inch.

Example: The following escape sequence will set line spacing to one half inch.

Escape Sequence:	ESC	3	108
Hexadecimal:	1B	33	6C

Set Line Spacing to *n*/72" **ESC A *n***

Sets the line spacing to *n*/72 of an inch per line. 0≥*n*≥255. Since the distance between print head wires is 1/72 of an inch, this is equivalent to setting *n* wire spacing. This spacing is stored but does not take effect until ESC 2 is received. Overrides the "LPI:" value in the "Setup: FORM" menu.

Example: The following escape sequence will set line spacing to 8/72 of an inch, for use with eight wire graphics.

Escape Sequence:	ESC	A	8
Hexadecimal:	1B	41	08

Horizontal Position

Carriage Return — CR

Causes the current line to be printed, and then sets the current print position to the left margin. If "Auto LF: On" is selected in the "Setup: INTERFACE" menu, a line feed will also be performed.

Control code: CR
Hexadecimal: 0D

Backspace — BS

Causes the current line to be printed, and then moves the current print position one space to the left. The actual distance moved depends on the current character spacing. Backspacing can be done up to, but not beyond, the left margin.

Control code: BS
Hexadecimal: 08

Vertical Position

Line Feed — LF

Causes the current line to be printed, and then advances the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: LF
Hexadecimal: 0A

Variable Distance Line Feed — ESC J *n*

Causes the current line to be printed, and then performs a single line feed of *n*/216ths of an inch. $0 \geq n \geq 255$. Does not change the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Example: The following escape sequence will advance the paper one half inch.

Escape Sequence: ESC J 108
Hexadecimal: 1B 4A 6C

Form Length and Form Feed

Form length is the distance from the top of the form to the bottom of the form. Form length may be specified either in inches, or in lines. A form feed will advance the paper to the top of the next form. Some programs do not send form feeds. Instead, they count line feeds, and send the appropriate number of line feeds to fill out the page. The usual rational is that the program is then in complete control of form length, and will work on any printer without requiring the correct form length to be set. However, the correct form length should always be set on the FormsPro 4000. Even if the program does not use form feeds, the printer will automatically scroll a completed form up to the tear bar to be torn off. This automatic scroll is based upon form length. The easiest way to set form length is via the "Length:" value in the "Setup: FORM" menu, so it will be correctly set for everyone using the form. If correct form length cannot be guaranteed from SETUP, then each program should set the correct form length.

Set Form Length in Lines **ESC C *n***

Sets the form length to *n* lines at the current line spacing. $1 \le n \le 255$. Maximum form length is 37.9 inches. Invalid form lengths will be ignored. Overrides the "Length:" value in the "Setup: FORM" menu.

For example, an 11 inch form contains 66 lines at 6 LPI, but 88 lines at 8 LPI. If line spacing is changed after setting the form length, the physical form length (in inches) will not be changed.

Resets top of form to the current position, so it is wise to be at top of form before setting form length. Issuing a form feed will guarantee this. Vertical margins are cleared.

Example: The following escape sequence will set form length to 66 lines. At 6 LPI, this will result in a form length of 11 inches.

Escape sequence:	ESC	C	66
Hexadecimal:	1B	43	42

Set Form Length in Inches **ESC C NUL *n***

Sets the form length to *n* inches. $1 \le n \le 37$. Maximum form length is 37.9 inches. Invalid form lengths will be ignored. Overrides the "Length:" value in the "Setup: FORM" menu.

Resets top of form to the current position, so it is wise to be at top of form before setting form length. Issuing a form feed will guarantee this. Vertical margins are cleared.

Example: The following escape sequence will set form length to 11 inches, regardless of what line spacing is set.

Escape sequence:	ESC	C	NUL	11
Hexadecimal:	1B	43	00	0B

Form Feed **FF**

Causes the current line to be printed, and then advances the paper to the top of the next form. If a top margin is set, printing will continue at the top margin. The "FF at TOF: No" value in the "Setup: INTERFACE" menu allows a form feed to be ignored if the paper is already at top of form. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	FF
Hexadecimal:	0A

Set Top of Form **ESC 4**

Sets top of form to the current position.

Escape Sequence:	ESC	4
Hexadecimal:	1B	34

Horizontal Tabs

Default horizontal tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. The default tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the default tab stops.

User defined horizontal tab stops are associated with absolute physical positions, not with columns. The tab stops are set relative to the current character spacing, but subsequent changes in character spacing will not affect the physical position of the tab stops (except that the position will be rounded up to the closest character boundary).

Horizontal Tab **HT**

Advances to the next horizontal tab stop. If no tab stop exists between the active column and the right margin, the HT will be ignored. Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. Different tab stops may be set with ESC D.

Control code:	HT
Hexadecimal:	09

Set Horizontal Tab Stops **ESC D *n1 n2 ... nx* NUL**

Clears all currently set horizontal tab stops, and sets new tab stops at column *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops must be presented in ascending order. The NUL character, or any tab stop value less than the preceding one, terminates the sequence. The tab stops are set relative to the current character spacing, but subsequent changes in character spacing will not affect the physical position of the tab stops (except that the position will be rounded up to the closest character boundary). The leftmost column is column one.

Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. The tab stops set by ESC D will replace the default tab stops. ESC D NUL will clear all tab stops, leaving no tab stops set. The default tab stops are restored by ESC R.

Example: The following escape sequence will set horizontal tab stops at half inch intervals, if character spacing is currently 10 cpi.

Escape Sequence:	ESC	D	6	11	16	21	26	31	NUL
Hexadecimal:	1B	44	06	0B	10	15	1A	1F	00

Vertical Tabs

Vertical tab stops are associated with absolute physical positions, not with lines. The tab stops are set relative to the current line spacing, but subsequent changes in line spacing will not affect the physical position of the tab stops.

Vertical Tab **VT**

Causes the current line to be printed, and then advances the paper to the next vertical tab stop. If no vertical tab stops are set, then a line feed is done instead. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	VT
Hexadecimal:	0B

Set Vertical Tab Stops **ESC B *n1 n2 ... nx* NUL**

Clears all currently set vertical tab stops, and sets new tab stops at line *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops must be presented in ascending order. The NUL character, or any tab stop value less than the preceding one, terminates the sequence. The tab stop settings are based on the current line spacing. Changing the line spacing after the tab stops are set will not affect the position of the tab stops. The first line is line one.

ESC B NUL or ESC R will clear all currently set vertical tab stops, leaving no vertical tab stops set.

Example: The following escape sequence will set vertical tab stops at line 7, 13, and 25. If line spacing is currently 6 lpi, this will result in tab stops one inch, two inches, and four inches from the top of the form.

Escape Sequence:	ESC	B	7	13	25	NUL
Hexadecimal:	1B	42	07	0D	19	00

Horizontal and Vertical Tabs

Reset Horizontal and Vertical Tab Stops **ESC R**

Clears all currently set horizontal tab stops, and returns to default horizontal tab stops. Default horizontal tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. Clears all currently set vertical tab stops.

Escape Sequence:	ESC	R
Hexadecimal:	1B	52

Horizontal Margins

Printing is allowed only within the left and right margins. Exceeding the right margin will cause line wrap, setting the current print position to the left margin and advancing the paper one line.

Set Left and Right Margin **ESC X *n1 n2***

Sets the left margin to column *n1* and the right margin to column *n2* at the current character spacing. $0 \geq n1 \geq 255$, $0 \geq n2 \geq 255$. If character spacing is changed after setting the margins, the position of the margins will not change.

The left margin is inclusive, but the right margin is exclusive. For example, a left margin at column 11 still allows a character to be printed in column 11. A right margin at column 76 allows a character to be printed in column 75, but not in column 76.

The leftmost column is column one. If *n1* or *n2* is zero, the corresponding margin is not changed. The left margin must be left of the right margin and ≤13.4 inches. The right margin must be right of the left margin and ≤13.6 inches. Invalid margins will be ignored. Overrides the "Left Mar:" and "Right Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a one inch left margin, and will set a right margin 7.5 inches from the left edge of the form, if character spacing is currently 10 cpi. For a standard 8.5 inch wide form, this would result in a one inch right margin.

Escape Sequence:	ESC	X	11	76
Hexadecimal:	1B	58	0B	4C

Vertical Margins

Printing is allowed only within the top and bottom margins. Exceeding the bottom margin will set the current line to the top margin of the next form.

Set Perforation Skip **ESC N *n***

Sets the perforation skip distance to *n* lines at the current line spacing. $1 \geq n \geq 255$. If line spacing is changed after setting the skip distance, the skip distance will not be changed.

The skip distance is split between the top and bottom margins, so the perforation will be centered in the resulting white space. The specified skip distance must be less than the form length, or the command will be ignored. Perforation skip is canceled by ESC O, ESC C *n* or ESC C NUL *n*. Overrides the "Top Mar:" and "Btm Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a two inch perforation skip distance, if the current line spacing is 6 lpi. This will result in a one inch top and bottom margin.

Escape Sequence:	ESC	N	12
Hexadecimal:	1B	4E	0C

Cancel Perforation Skip **ESC O**

Cancels perforation skip. This is equivalent to having no top and bottom margin. Overrides the "Top Mar:" and "Btm Mar:" values in the "Setup: FORM" menu.

Escape Sequence:	ESC	O
Hexadecimal:	1B	4F

Graphics

Graphics mode gives the user complete control over every dot position on the paper. Graphics may be printed with various horizontal densities from 60 to 240 dpi, and a vertical density of 72 dpi.

Each byte of graphics data represents a vertical column of eight dots, with the MSB (most significant bit) corresponding to the top wire of the print head. Turning a bit on causes a dot to be printed. The bit values corresponding to each wire of the print head are shown below:

wire 1	128	(80 hex)
wire 2	64	(40 hex)
wire 3	32	(20 hex)
wire 4	16	(10 hex)
wire 5	8	(08 hex)
wire 6	4	(04 hex)
wire 7	2	(02 hex)
wire 8	1	(01 hex)

The appropriate bit values are added together to fire the desired wires. For example, a byte of graphics data with the value 128 (80 hex) will fire the top wire, wire 1. A value of 192 (C0 hex) will fire the top two wires, wires 1 and 2. A value of 11 (0B hex) will fire wires 5, 7 and 8.

Each graphics sequence contains two bytes (*n1* and *n2*) that specify how many bytes of graphics data follow. The first byte, *n1*, can specify values up to 255. If that is sufficient, then *n2* is set to zero. For values greater than 255, *n2* comes into play. The *n2* byte specifies multiples of 256. For example, to specify 520 bytes of graphics data, *n1* = 8 and *n2* = 2. The bytes of graphics data are strung together to create a graphics line that is eight dots high, and *n1* + (*n2* x 256) dots long. Be sure to provide the amount of graphics data that you specify, because the printer will not leave graphics mode until it has accepted the specified number of data bytes.

If "Data Bits: 7" is specified in the "Setup: INTERFACE" menu, beware of potential problems in graphics mode. Since the MSB (most significant bit) will always be turned off, it will not be possible to fire the top wire of the print head. Worse yet, the value of *n1* or *n2* may be changed. For example, if *n1* specifies 200 bytes of data, and its MSB is turned off, the printer will only expect 72 bytes of data. It will exit graphics mode, and then try to print the remaining 128 bytes of graphics data as normal text characters. The result will surely not be pretty. To avoid such problems, the use of an 8-bit I/O interface for printing graphics is highly recommended.

The normal graphics modes allow every dot to be printed. High speed graphics will print twice as fast, but will not allow consecutive dots to be printed.

60 DPI Graphics **ESC K *n1 n2 data***

Selects eight wire single density (60 dpi) graphics for *n1* + (*n2* x 256) columns of data.

Example: The following escape sequence will print six bytes of graphics data at 60 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	K	6	0	128	64	32	16	8	4
Hexadecimal:	1B	4B	06	00	80	40	20	10	08	04

120 DPI Graphics **ESC L *n1 n2 data***

Selects eight wire double density (120 dpi) graphics for *n1* + (*n2* x 256) columns data.

Example: The following escape sequence will print six bytes of graphics data at 120 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	L	6	0	128	64	32	16	8	4
Hexadecimal:	1B	4C	06	00	80	40	20	10	08	04

High Speed 120 DPI Graphics **ESC Y *n1 n2 data***

Selects eight wire high speed double density (120 dpi) graphics for *n1* + (*n2* x 256) columns of data. Horizontally adjacent dots may not be printed.

Example: The following escape sequence will print six bytes of graphics data at 120 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	Y	6	0	128	64	32	16	8	4
Hexadecimal:	1B	59	06	00	80	40	20	10	08	04

High Speed 240 DPI Graphics **ESC Z *n1 n2 data***

Selects eight wire quadruple density (240 dpi) graphics for *n1* + (*n2* x 256) columns of data. Horizontally adjacent dots may not be printed.

Example: The following escape sequence will print six bytes of graphics data at 240 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	Z	6	0	128	64	32	16	8	4
Hexadecimal:	1B	5A	06	00	80	40	20	10	08	04

Printer Controls

Bell **BEL**

Causes the printer's bell to sound.

Control code:	BEL
Hexadecimal:	07

Unidirectional Mode **ESC U *n***

Selects unidirectional mode for *n*=1, or bidirectional mode for *n*=0. Printing is normally bidirectional. Unidirectional printing provides more accurate positioning, but causes lower throughput.

Example: The following escape sequence will force unidirectional printing.

Escape Sequence:	ESC	U	1
Hexadecimal:	1B	55	31

Automatic Line Feed **ESC 5 *n***

Selects automatic line feed mode for *n*=1, or cancels for *n*=0. Automatic line feed mode causes the printer to automatically perform a line feed (LF) for each carriage return (CR) it receives. Overrides the "Auto LF:" value in the "Setup: INTERFACE" menu.

Example: The following escape sequence will select automatic line feed mode.

Escape Sequence:	ESC	5	1
Hexadecimal:	1B	35	31

Emulations

Select Software Interface *n* **ESC ESC *n***

Selects the software interface *n* according to the table below.

n	Software Interface
0	Test (reserved for factory use)
1	ANSI X3.64 Emulation
2	Epson FX Emulation
3	Bar Code Mode (optional)
4	IBM Proprinter Emulation
5	DEC LA120 Emulation
6	TTY Emulation
7	Printek Emulation
?	Previously Selected Emulation
@	Default Emulation

Overrides the "Mode:" value in the "Setup: INTERFACE" menu. "Mode: BarberPole" and "Mode: Hex Dump" cannot be overridden.

A numeric value for *n* may be specified in two different ways, with equivalent results: a single byte with a value of 00 to 07 hex, or a single printable ASCII character "0" to "7" (30 to 37 hex).

If more than one emulation has been selected, ESC ESC ? will return to the previously selected emulation. This is particularly useful when the previous emulation is unknown. Please beware that the memory (stack) is only one level deep.

ESC ESC @ will return to the default emulation, as specified by the "Mode:" value in the "Setup: INTERFACE" menu.

This chapter describes IBM Proprinter emulation. If a different interface is selected, the control codes and escape sequences described in this chapter will no longer be applicable.

Example: The following escape sequences will select Printek emulation, load form one, and then return to the previous emulation.

Escape Sequence:	ESC	ESC	7	ESC	L	1	ESC	ESC	?
Hexadecimal:	1B	1B	07	1B	4C	01	1B	1B	3F

Control Codes and Escape Sequences
Sorted Alphabetically

BEL	Bell
BS	Backspace
CAN	Cancel Line
CR	Carriage Return
DC2	Select 10 CPI
DC4	Cancel Double-Wide Mode (one line)
ESC - *n*	Underline Mode
ESC 0	Select 8 LPI
ESC 1	Set Line Spacing to 7/72"
ESC 2	Start Line Spacing
ESC 3 *n*	Set Line Spacing to *n*/216"
ESC 4	Set Top of Form
ESC 5 *n*	Automatic Line Feed
ESC 6	Select Character Set 2
ESC 7	Select Character Set 1
ESC :	Select 12 CPI
ESC A *n*	Set Line Spacing to *n*/72"
ESC B *n1 n2 ... nx* NUL	Set Vertical Tab Stops
ESC C NUL *n*	Set Form Length in Inches
ESC C *n*	Set Form Length in Lines
ESC D *n1 n2 ... nx* NUL	Set Horizontal Tab Stops
ESC E	Select Emphasized Mode
ESC ESC *n*	Select Software Interface *n*
ESC F	Cancel Emphasized Mode
ESC G	Select Double-Strike Mode
ESC H	Cancel Double-Strike Mode
ESC I *n*	Select Print Mode
ESC J *n*	Variable Distance Line Feed
ESC K *n1 n2 data*	60 DPI Graphics
ESC L *n1 n2 data*	120 DPI Graphics
ESC N *n*	Set Perforation Skip
ESC O	Cancel Perforation Skip
ESC Q *n*	Deselect Printer
ESC R	Reset Horizontal and Vertical Tab Stops
ESC S *n*	Select Subscript or Superscript Mode
ESC SI	Select Condensed Mode
ESC SO	Select Double-Wide Mode (one line)
ESC T	Cancel Subscript and Superscript Mode
ESC U *n*	Unidirectional Mode
ESC W *n*	Double-Wide Mode

ESC X *n1 n2*	Set Left and Right Margin
ESC Y *n1 n2 data*	High Speed 120 DPI Graphics
ESC Z *n1 n2 data*	High Speed 240 DPI Graphics
ESC [@ *n1 n2 m1 m2 m3 m4*	Double-High Mode
ESC \ *n1 n2*	Print Characters
ESC ^ *n*	Print Single Character
ETX	End of Text
FF	Form Feed
HT	Horizontal Tab
LF	Line Feed
SI	Select Condensed Mode
SO	Select Double-Wide Mode (one line)
VT	Vertical Tab

DEC LA120 EMULATION

Introduction

This section describes the control codes and escape sequences comprising DEC LA120 emulation. This emulation may be selected by specifying "Mode: LA120" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 5** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

The LA120 control codes and escape sequences follow the standards of the ANSI X3.64 specification. Many ANSI escape sequences begin with a two character Control Sequence Introducer (CSI), Escape Left Square Bracket (**ESC [**, 1B 5B hex). If 8-bit data is selected via control panel setup, these two characters may be replaced by a single character CSI, 9B hex. The sequences are always documented in this section with the two character CSI (**ESC [**), because this format seems to be much more common, and works equally well with 7-bit or 8-bit data.

Some escape sequences accept one or more numeric parameters. A numeric parameter is a decimal number represented by a string of ASCII decimal digits ("0" through "9"). Leading zeros may be supplied, but are not necessary. Due to implementation constraints, the largest value that can be accepted is decimal 255. Larger values will be treated as zero. Omitting a numeric parameter is equivalent to supplying a value of zero.

If a sequence accepts one numeric parameter, it will be represented as "*n*". If a sequence accepts more than one numeric parameter, they will be represented as "*n1*; *n2*; ... *nx*". Note that multiple numeric parameters are separated by a semicolon.

Most LA120 escape sequences will assume one of the following formats:

ESC *f*	(no numeric parameters)
ESC *n f*	(one numeric parameter)
ESC *n1*; *n2*; ... *nx f*	(two or more numeric parameters)

The "*f*" at the end of the escape sequence represents the final character. It terminates the sequence, and specifies the function to be performed.

Spaces are used when documenting escape sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*" and "*f*" above) are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **BS** is the Backspace control code (08 hex), not the two characters "B" and "S" (42 and 53 hex). An ASCII Control Code Table is contained in the appendices for your convenience. If you have any doubt about how to interpret a documented control code or escape sequence, refer to the hex representation in the provided example. This should clarify any ambiguity. The examples may also be helpful when analyzing a hex dump (see chapter 8) printed by the printer.

Some escape sequences refer to the active column or active line. The active column is the column where the next character will be printed. Printing a character or a space will increment the active column. The active line is the line where the next character will be printed. A line feed will increment the active line. Column and line numbers begin at one, not at zero. Keep this in mind when setting tabs, margins, etc.

Control Codes and Escape Sequences Grouped by Function

Communications

Null **NUL**

This control code is ignored by the printer.

Control code: NUL
Hexadecimal: 00

Delete **DEL**

This control code is ignored by the printer.

Control code: DEL
Hexadecimal: 7F

End of Text **ETX**

If "ETX/ACK: On" is specified in the "Setup: INTERFACE" menu, then receipt of an ETX causes the printer to transmit an ACK to the host computer.

Since the ETX may be a legal value within an escape sequence, it is the user's responsibility to ensure that an ETX used for data handshake is not sent within an escape sequence. The user must also ensure that the maximum block size or the number of blocks sent at one time does not exceed the input buffer size of the printer.

ETX/ACK handshake is available only with serial I/O. It is not available when using the parallel interface or the coaxial/twinaxial interface.

Control code: ETX
Hexadecimal: 03

Character Size

The FormsPro 4000 is capable of supporting 10, 12, 13.3, 15, 16.7, 17.14, and 20 cpi, but most emulations support only a subset of these. LA120 emulation supports 10, 12, 13.3, and 16.7 cpi via software, but does not support 15, 17.14, or 20 cpi. Every emulation supports 10 cpi, and we consider this to be the default character pitch. When you use the control panel to change the "CPI:" value in the "Setup: FORM" menu, you are actually changing the default character pitch. When the printer is turned on (or reset), it will use this character pitch. You can even use a pitch that is not supported by your emulation, such as 15 cpi with LA120 emulation. You can override this pitch selection via software, by sending an escape sequence. This selects a user specified non-default pitch. For example, in LA120 emulation, sending ESC [2w will select 12 cpi. Sending ESC [w will re-select 10 cpi, and thus re-select the default character pitch that was selected in the form setup.

Via software escape sequences, you can select any character pitch supported by the emulation you are using. All will print as expected, unless you select 10 cpi -- because 10 cpi really selects the default character pitch from setup. If you really want 10 cpi, then you must specify "CPI: 10" in the "Setup: FORM" menu. Likewise, if you want to use the default pitch from setup, you must not override it. Either send no character pitch sequences to the printer, or make sure you re-select 10 cpi via software.

When you select different forms, the default character pitch from setup is selected along with the form. But you will not see this default pitch if it has already been overridden via software.

Set Character Spacing **ESC [*n* w**

Sets the character spacing as specified in the following table. Omitting *n* is equivalent to specifying zero.

n	character pitch
0	10 cpi
1	10 cpi
2	12 cpi
3	13.3 cpi
4	16.74 cpi
5	5 cpi
6	6 cpi
7	6.67 cpi
8	8.37 cpi

Overrides the "CPI:" value in the "Setup: FORM" menu.

Example: The following escape sequence will select 10 cpi character spacing. If "CPI: 10" was not specified in the "Setup: FORM" menu, the specified default character pitch will be selected instead of 10 cpi.

Escape Sequence:	ESC	[	w
Hexadecimal:	1B	5B	77

Example: The following escape sequence will select 12 cpi character spacing.

Escape Sequence:	ESC	[	2	w
Hexadecimal:	1B	5B	32	77

Character Attributes

Select Graphic Rendition **ESC [*n* m**

Selects the graphic rendition *n* from the following table.

n	Rendition
0	Normal
1	Emphasized
3	Italic
4	Underline

For italic mode to work correctly, an Epson FX font must be selected (check the "Font:" value in the "Setup: FORM" menu). The other available fonts do not include italic characters.

Example: The following escape sequence will select emphasized mode.

Escape Sequence:	ESC	[	1	m
Hexadecimal:	1B	5B	31	6D

Character Sets

Select International Character Set **ESC (*a***

Selects the international character set as specified by the character *a* in the following table. Overrides the "Lang:" value in the "Setup: FORM" menu.

a	Character Set
A	United Kingdom
B	United States of America
C	Sweden
E	Denmark
H	Sweden
K	Germany
R	France

The actual character substitutions are shown in the "International Character Mapping" table below. For this to work correctly, an Epson FX font must be selected (check the "Font:" value in the "Setup: FORM" menu).

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	$	@	[	\	]	^	`	{	¦	}	~
France	#	$	à	°	ç	§	^	`	é	ù	è	¨
Germany	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
England	£	$	@	[	\	]	^	`	{	¦	}	~
Denmark	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
Sweden	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
Italy	#	$	@	°	\	é	^	ù	à	ò	è	ì
Spain	Pts	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
Japan	#	$	@	[	¥	]	^	`	{	¦	}	~

Example: The following escape sequence will select the German character set.

Escape Sequence: ESC (K
Hexadecimal: 1B 28 4B

Line Pitch

Set Line Spacing **ESC [*n* z**

Sets the line spacing as specified in the following table. Omitting *n* is equivalent to specifying zero.

n	line pitch
0	6 lpi
1	6 lpi
2	8 lpi
3	12 lpi
4	2 lpi
5	3 lpi
6	4 lpi

Overrides the "LPI:" value in the "Setup: FORM" menu.

Example: The following escape sequence will set line spacing to 1/6 of an inch per line (6 lpi).

Escape Sequence:	ESC	[	z
Hexadecimal:	1B	5B	7A

Example: The following escape sequence will set line spacing to 1/8 of an inch per line (8 lpi).

Escape Sequence:	ESC	[	2	z
Hexadecimal:	1B	5B	32	7A

Horizontal Position

Carriage Return — CR

Causes the current line to be printed, and then sets the current print position to the left margin. If "Auto LF: On" is selected in the "Setup: INTERFACE" menu, a line feed will also be performed.

Control code: CR
Hexadecimal: 0D

Backspace — BS

Causes the current line to be printed, and then moves the current print position one space to the left. The actual distance moved depends on the current character spacing. Backspacing can be done up to, but not beyond, the left margin.

Control code: BS
Hexadecimal: 08

Absolute Horizontal Tab — ESC [*n* `

Sets the current print position to column *n*. The actual position will depend on the current character spacing. If *n* is less than the left margin, the active column will be set to the left margin. If *n* is greater than the right margin, then a line feed will be performed and the active column will be set to the left margin.

Example: The following escape sequence will set the active column to column 65.

Escape Sequence:	ESC	[	6	5	`
Hexadecimal:	1B	5B	36	35	60

Relative Horizontal Tab — ESC [*n* a

Advances the current print position by *n* columns. The actual distance moved will depend on the current character spacing. Equivalent to sending *n* spaces (SP).

Example: The following escape sequence will advance the active column by 10 columns. If current character spacing is 10 cpi, this will cause the print position to move one inch to the right.

Escape Sequence:	ESC	[	1	0	a
Hexadecimal:	1B	5B	31	30	61

Vertical Position

Line Feed **LF**
(or) **IND**
(or) **ESC D**

Causes the current line to be printed, and then advances the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	LF	
Hexadecimal:	0A	
Control code:	IND	
Hexadecimal:	84	
Escape Sequence:	ESC	D
Hexadecimal:	1B	44

Absolute Vertical Tab **ESC [*n* d**

Sets the current line to line *n* of the current form. The actual position will depend on the current line spacing.

Example: The following escape sequence will set the active line to line 12.

Escape Sequence:	ESC	[	1	2	d
Hexadecimal:	1B	5B	31	32	64

Relative Vertical Tab **ESC [*n* e**

Advances the active line by *n* lines. The actual distance moved will depend on the current line spacing. Equivalent to sending *n* line feeds (LF).

Example: The following escape sequence will advance the active line by 12 lines. If current line spacing is 6 lpi, this will cause the paper to advance one inch.

Escape Sequence:	ESC	[	1	2	e
Hexadecimal:	1B	5B	31	32	65

Horizontal and Vertical Position

New Line **NEL**
(or) **ESC E**

Causes the current line to be printed, and then sets the current print position to the left margin and performs a line feed. Equivalent to a carriage return (CR) line feed (LF) combination.

Control code:	NEL
Hexadecimal:	85

Escape Sequence:	ESC E
Hexadecimal:	1B 45

Form Length and Form Feed

Form length is the distance from the top of the form to the bottom of the form. A form feed will advance the paper to the top of the next form. Some programs do not send form feeds. Instead, they count line feeds, and send the appropriate number of line feeds to fill out the page. The usual rational is that the program is then in complete control of form length, and will work on any printer without requiring the correct form length to be set. However, the correct form length should always be set on the FormsPro 4000. Even if the program does not use form feeds, the printer will automatically scroll a completed form up to the tear bar to be torn off. This automatic scroll is based upon form length. The easiest way to set form length is via the "Length:" value in the "Setup: FORM" menu, so it will be correctly set for everyone using the form. If correct form length cannot be guaranteed from SETUP, then each program should set the correct form length.

Set Form Length in Lines **ESC [*n* t**

Sets the form length to *n* lines at the current line spacing. $1 \geq n \geq 255$. Maximum form length is 37.9 inches. Invalid form lengths will be ignored. Overrides the "Length:" value in the "Setup: FORM" menu.

For example, an 11 inch form contains 66 lines at 6 LPI, but 88 lines at 8 LPI. If line spacing is changed after setting the form length, the physical form length (in inches) will not be changed.

Resets top of form to the current position, so it is wise to be at top of form before setting form length. Issuing a form feed will guarantee this. Vertical margins are cleared.

Example: The following escape sequence will set form length to 66 lines. At 6 LPI, this will result in a form length of 11 inches.

Escape sequence:	ESC	[	6	6	t
Hexadecimal:	1B	5B	36	36	74

Form Feed **FF**

Causes the current line to be printed, and then advances the paper to the top of the next form. If a top margin is set, printing will continue at the top margin. The "FF at TOF: No" value in the "Setup: INTERFACE" menu allows a form feed to be ignored if the paper is already at top of form. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	FF
Hexadecimal:	0A

Horizontal Tabs

Horizontal tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the tab stops. Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. If different tab stops are to be set, the default tab stops should first be cleared.

Horizontal Tab **HT**

Advances to the next horizontal tab stop. If no tab stop exists between the active column and the right margin, the HT will be ignored. Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. Different tab stops may be set with ESC H, ESC 1, or ESC [*n1* ; *n2* ; ... *nx* u.

Control code:	HT
Hexadecimal:	09

Set Horizontal Tab Stop **HTS**
(or) **ESC H**
(or) **ESC 1**

Sets a horizontal tab stop at the current print position. The tab stop is associated with the active column, not an absolute physical position. Changing character spacing will change the physical position of the tab stop.

Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. The tab stop set by this escape sequence will be added to previously set tab stops, including the default tab stops. If this is not desired, the old tab stops should first be cleared.

Control code:	HTS	
Hexadecimal:	88	
Escape Sequence:	ESC	H
Hexadecimal:	1B	48
Escape Sequence:	ESC	1
Hexadecimal:	1B	31

Set Horizontal Tab Stops **ESC [*n1* ; *n2* ; ... *nx* u**

Sets new horizontal tab stops at column *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the tab stops. The leftmost column is column one.

Default tab stops are set at every eighth column, i.e. column 9, 17, 25, 33, 41, etc. The tab stops set by this escape sequence will be added to previously set tab stops,

including the default tab stops. If this is not desired, the old tab stops should first be cleared.

Example: The following escape sequence will set horizontal tab stops at five column intervals.

Escape Sequence:	ESC	[	6	;	1	1	;	1	6	u
Hexadecimal:	1B	5B	36	3B	31	31	3B	31	36	75

Example: The following escape sequence will set a horizontal tab stop at column six.

Escape Sequence:	ESC	[	6	u
Hexadecimal:	1B	5B	36	75

Clear Horizontal Tab Stop **ESC [g**
(or) **ESC [0 g**

Clears the horizontal tab stop at the current print position. The tab stop to be cleared is associated with the active column (based upon the current character spacing), not an absolute physical position.

Escape Sequence:	ESC	[	g
Hexadecimal:	1B	5B	67

Clear All Horizontal Tab Stops **ESC 2**
(or) **ESC [2 g**
(or) **ESC [3 g**

Clears all currently set horizontal tab stops.

Escape Sequence:	ESC	2
Hexadecimal:	1B	32

Escape Sequence:	ESC	[	2	g
Hexadecimal:	1B	5B	32	67

Escape Sequence:	ESC	[	3	g
Hexadecimal:	1B	5B	33	67

Vertical Tabs

Vertical tab stops are associated with lines, not absolute physical positions. Changing line spacing will change the physical position of the tab stops.

Vertical Tab **VT**

Causes the current line to be printed, and then advances the paper to the next vertical tab stop. If no vertical tab stops are set, then a line feed is done instead. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: VT
Hexadecimal: 0B

Set Vertical Tab Stop **VTS**
(or) **ESC J**
(or) **ESC 3**

Sets a vertical tab stop at the current line. The tab stop is associated with the active line, not an absolute physical position. Changing line spacing will change the physical position of the tab stop.

The tab stop set by this escape sequence will be added to previously set tab stops. If this is not desired, the old tab stops should first be cleared.

Control code: VTS
Hexadecimal: 8A

Escape Sequence: ESC J
Hexadecimal: 1B 4A

Escape Sequence: ESC 3
Hexadecimal: 1B 33

Set Vertical Tab Stops **ESC [*n1* ; *n2* ; ... *nx* v**

Sets new vertical tab stops at line *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops are associated with lines, not absolute physical positions. Changing line spacing will change the physical position of the tab stops. The first line is line one.

The tab stops set by this escape sequence will be added to previously set tab stops. If this is not desired, the old tab stops should first be cleared.

Example: The following escape sequence will set vertical tab stops at line 7, 13, and 25. If line spacing is 6 lpi, this will result in tab stops one inch, two inches, and four inches from the top of the form.

Escape Sequence:	ESC	[	7	;	1	3	;	2	5	v
Hexadecimal:	1B	5B	37	3B	31	33	3B	32	35	76

Example: The following escape sequence will set a vertical tab stop at line seven.

Escape Sequence:	ESC	[	7	v
Hexadecimal:	1B	5B	37	76

Clear Vertical Tab Stop **ESC [1 g**

Clears the vertical tab stop at the current line. The tab stop to be cleared is associated with the active line (based upon the current line spacing), not an absolute physical position.

Escape Sequence:	ESC	[	1	g
Hexadecimal:	1B	5B	31	67

Clear All Vertical Tab Stops **ESC 4**
(or) **ESC [4 g**

Clears all currently set vertical tab stops.

Escape Sequence:	ESC	4
Hexadecimal:	1B	34

Escape Sequence:	ESC	[	4	g
Hexadecimal:	1B	5B	34	67

Horizontal Margins

Printing is allowed only within the left and right margins. Exceeding the right margin will cause line wrap, setting the current print position to the left margin and advancing the paper one line.

Set Left and Right Margin **ESC [*n1* ; *n2* s**

Sets the left margin to column *n1* and the right margin to column *n2* at the current character spacing. $0 \geq n1 \geq 255$, $0 \geq n2 \geq 255$. If character spacing is changed after setting the margins, the position of the margins will not change.

The margin settings are inclusive. For example, a left margin at column 11 allows a character to be printed in column 11, but not in column 10. A right margin at column 75 allows a character to be printed in column 75, but not in column 76.

The leftmost column is column one. If *n1* or *n2* is zero (or is omitted), the corresponding margin is not changed. The left margin must be left of the right margin and ≤13.4 inches. The right margin must be right of the left margin and ≤13.6 inches. Invalid margins will be ignored. Overrides the "Left Mar:" and "Right Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a one inch left margin, and will set a right margin 7.5 inches from the left edge of the form, if character spacing is currently 10 cpi. For a standard 8.5 inch wide form, this would result in a one inch right margin.

Escape Sequence:	ESC	[	1	0	;	7	5	s
Hexadecimal:	1B	5B	31	30	3B	37	35	73

Example: The following escape sequence will set the left margin to column 10, without affecting the right margin.

Escape Sequence:	ESC	[	1	0	s
Hexadecimal:	1B	5B	31	30	73

Example: The following escape sequence will set the right margin to column 75, without affecting the left margin.

Escape Sequence:	ESC	[	;	7	5	s
Hexadecimal:	1B	5B	3B	37	35	73

Vertical Margins

Printing is allowed only within the top and bottom margins. Exceeding the bottom margin will set the current line to the top margin of the next form.

Set Top and Bottom Margins **ESC [*n1* ; *n2* r**

Sets the top margin to line *n1* and the bottom margin to line *n2* at the current line spacing. $0 \geq n1 \geq 255$, $0 \geq n2 \geq 255$. If line spacing is changed after setting the margins, the position of the margins will not change. Vertical margins are cleared by ESC [*n* t.

The top and bottom margins are both inclusive. For example, a top margin at line 7 still allows text to be printed on line 7, but not on line 6. A bottom margin at line 60 still allows text to be printed on line 60, but not on line 61.

The first line is line one. If *n1* or *n2* is zero (or is omitted), the corresponding margin is not changed. The top margin must be above the bottom margin. The bottom margin must be below the top margin. The margins cannot exceed the form length. Invalid margins will be ignored. Overrides the "Top Mar:" and "Btm Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a top margin at line 7, and will set a bottom margin at line 60. For a standard 11 inch form with 6 lpi line spacing, this would result in one inch top and bottom margins.

Escape Sequence:	ESC	[	7	;	6	0	r
Hexadecimal:	1B	5B	37	3B	36	30	72

Example: The following escape sequence will set a top margin at line 7, without affecting the bottom margin.

Escape Sequence:	ESC	[	7	r
Hexadecimal:	1B	5B	37	72

Example: The following escape sequence will set a bottom margin at line 60, without affecting the top margin.

Escape Sequence:	ESC	[	;	6	0	r
Hexadecimal:	1B	5B	3B	36	30	72

Printer Controls

Bell **BEL**

Causes the printer's bell to sound.

Control code:	BEL
Hexadecimal:	07

Select Automatic Carriage Return **ESC [20 h**

Selects automatic carriage return mode. This causes the printer to automatically perform a carriage return (CR) for each line feed (LF), vertical tab (VT), or form feed (FF) that it receives. Overrides the "Auto CR:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	[	2	0	h
Hexadecimal:	1B	5B	32	30	68

Cancel Automatic Carriage Return **ESC [20 l**

Cancels automatic carriage return mode. Overrides the "Auto CR:" value in the "Setup: INTERFACE" menu.

Escape Sequence:	ESC	[	2	0	l
Hexadecimal:	1B	5B	32	30	6C

Printer Identification **ESC [c**
(or) **ESC [0 c**

Causes the printer to respond with ESC [? 2 c to identify itself as an LA120-RA printer. (The response can only be sent if serial I/O is selected.)

Emulations

Select Software Interface *n* **ESC ESC *n***

Selects the software interface *n* according to the table below.

n	Software Interface
0	Test (reserved for factory use)
1	ANSI X3.64 Emulation
2	Epson FX Emulation
3	Bar Code Mode (optional)
4	IBM Proprinter Emulation
5	DEC LA120 Emulation
6	TTY Emulation
7	Printek Emulation
?	Previously Selected Emulation
@	Default Emulation

Overrides the "Mode:" value in the "Setup: INTERFACE" menu. "Mode: BarberPole" and "Mode: Hex Dump" cannot be overridden.

A numeric value for *n* may be specified in two different ways, with equivalent results: a single byte with a value of 00 to 07 hex, or a single printable ASCII character "0" to "7" (30 to 37 hex).

If more than one emulation has been selected, ESC ESC ? will return to the previously selected emulation. This is particularly useful when the previous emulation is unknown. Please beware that the memory (stack) is only one level deep.

ESC ESC @ will return to the default emulation, as specified by the "Mode:" value in the "Setup: INTERFACE" menu.

This chapter describes DEC LA120 emulation. If a different interface is selected, the control codes and escape sequences described in this chapter will no longer be applicable.

Example: The following escape sequences will select Printek emulation, load form one, and then return to the previous emulation.

Escape Sequence:	ESC	ESC	7	ESC	L	1	ESC	ESC	?
Hexadecimal:	1B	1B	07	1B	4C	01	1B	1B	3F

Control Codes and Escape Sequences
Sorted Alphabetically

BEL	Bell
BS	Backspace
CR	Carriage Return
DEL	Delete
ESC (*a*	Select International Character Set
ESC 1	Set Horizontal Tab Stop
ESC 2	Clear All Horizontal Tab Stops
ESC 3	Set Vertical Tab Stop
ESC 4	Clear All Vertical Tab Stops
ESC D	Line Feed
ESC E	New Line
ESC ESC *n*	Select Software Interface *n*
ESC H	Set Horizontal Tab Stop
ESC J	Set Vertical Tab Stop
ESC [*n* `	Absolute Horizontal Tab
ESC [*n* a	Relative Horizontal Tab
ESC [c	Printer Identification
ESC [0 c	Printer Identification
ESC [*n* d	Absolute Vertical Tab
ESC [*n* e	Relative Vertical Tab
ESC [g	Clear Horizontal Tab Stop
ESC [0 g	Clear Horizontal Tab Stop
ESC [1 g	Clear Vertical Tab Stop
ESC [2 g	Clear All Horizontal Tab Stops
ESC [3 g	Clear All Horizontal Tab Stops
ESC [4 g	Clear All Vertical Tab Stops
ESC [20 h	Select Automatic Carriage Return
ESC [20 l	Cancel Automatic Carriage Return
ESC [*n* m	Select Graphic Rendition
ESC [*n1* ; *n2* r	Set Top and Bottom Margins
ESC [*n1* ; *n2* s	Set Left and Right Margin
ESC [*n* t	Set Form Length in Lines
ESC [*n1* ; *n2* ; ... *nx* u	Set Horizontal Tab Stops
ESC [*n1* ; *n2* ; ... *nx* v	Set Vertical Tab Stops
ESC [*n* w	Set Character Spacing
ESC [*n* z	Set Line Spacing
ETX	End of Text
FF	Form Feed
HT	Horizontal Tab
HTS	Set Horizontal Tab Stop

IND	Line Feed
LF	Line Feed
NEL	New Line
NUL	Null
VT	Vertical Tab
VTS	Set Vertical Tab Stop

SIMPLE TTY EMULATION

Introduction

This section describes the control codes and escape sequences comprising simple TTY emulation. This emulation may be selected by specifying "Mode: TTY" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 6** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

TTY emulation is unique in that it does not support any escape sequences (except for the **ESC ESC *n*** sequence, which may be used to select a different emulation).

Spaces are used when documenting escape sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*") are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **BS** is the Backspace control code (08 hex), not the two characters "B" and "S" (42 and 53 hex). An ASCII Control Code Table is contained in the appendices for your convenience. If you have any doubt about how to interpret a documented control code or escape sequence, refer to the hex representation in the provided example. This should clarify any ambiguity. The examples may also be helpful when analyzing a hex dump (see chapter 8) printed by the printer.

Control Codes and Escape Sequences Grouped by Function

Communications

End of Text **ETX**

If "ETX/ACK: On" is specified in the "Setup: INTERFACE" menu, then receipt of an ETX causes the printer to transmit an ACK to the host computer.

Since the ETX may be a legal value within an escape sequence, it is the user's responsibility to ensure that an ETX used for data handshake is not sent within an escape sequence. The user must also ensure that the maximum block size or the number of blocks sent at one time does not exceed the input buffer size of the printer.

ETX/ACK handshake is available only with serial I/O. It is not available when using the parallel interface or the coaxial/twinaxial interface.

Control code: ETX
Hexadecimal: 03

Horizontal Position

Carriage Return **CR**

Causes the current line to be printed, and then sets the current print position to the left margin. If "Auto LF: On" is selected in the "Setup: INTERFACE" menu, a line feed will also be performed.

Control code: CR
Hexadecimal: 0D

Backspace **BS**

Causes the current line to be printed, and then moves the current print position one space to the left. The actual distance moved depends on the current character spacing. Backspacing can be done up to, but not beyond, the left margin.

Control code: BS
Hexadecimal: 08

Vertical Position

Line Feed **LF**

Causes the current line to be printed, and then advances the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: LF
Hexadecimal: 0A

Form Length and Form Feed

Form length is the distance from the top of the form to the bottom of the form. A form feed will advance the paper to the top of the next form. Some programs do not send form feeds. Instead, they count line feeds, and send the appropriate number of line feeds to fill out the page. The usual rational is that the program is then in complete control of form length, and will work on any printer without requiring the correct form length to be set. However, the correct form length should always be set on the FormsPro 4000. Even if the program does not use form feeds, the printer will automatically scroll a completed form up to the tear bar to be torn off. This automatic scroll is based upon form length. The easiest way to set form length is via the "Length:" value in the "Setup: FORM" menu, so it will be correctly set for everyone using the form.

Form Feed **FF**

Causes the current line to be printed, and then advances the paper to the top of the next form. If a top margin is set, printing will continue at the top margin. The "FF at TOF: No" value in the "Setup: INTERFACE" menu allows a form feed to be ignored if the paper is already at top of form. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: FF
Hexadecimal: 0A

Horizontal Tabs

Default horizontal tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. (The first column is column zero.) The default tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the default tab stops.

Horizontal Tab **HT**

Advances to the next horizontal tab stop. If no tab stop exists between the active column and the right margin, the HT will be ignored. Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc.

Control code: HT
Hexadecimal: 09

Vertical Tabs

Vertical Tab **VT**

Causes the current line to be printed, and then advances the paper to the next vertical tab stop. If no vertical tab stops are set, then a line feed is done instead. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

It is not possible to set vertical tab stops in TTY emulation. If tab stops were previously set in some other emulation, they will be used.

Control code: VT
Hexadecimal: 0B

Printer Controls

Bell **BEL**

Causes the printer's bell to sound.

Control code: BEL
Hexadecimal: 07

Emulations

Select Software Interface *n* **ESC ESC *n***

Selects the software interface *n* according to the table below.

n	Software Interface
0	Test (reserved for factory use)
1	ANSI X3.64 Emulation
2	Epson FX Emulation
3	Bar Code Mode (optional)
4	IBM Proprinter Emulation
5	DEC LA120 Emulation
6	TTY Emulation
7	Printek Emulation
?	Previously Selected Emulation
@	Default Emulation

Overrides the "Mode:" value in the "Setup: INTERFACE" menu. "Mode: BarberPole" and "Mode: Hex Dump" cannot be overridden.

A numeric value for *n* may be specified in two different ways, with equivalent results: a single byte with a value of 00 to 07 hex, or a single printable ASCII character "0" to "7" (30 to 37 hex).

If more than one emulation has been selected, ESC ESC ? will return to the previously selected emulation. This is particularly useful when the previous emulation is unknown. Please beware that the memory (stack) is only one level deep.

ESC ESC @ will return to the default emulation, as specified by the "Mode:" value in the "Setup: INTERFACE" menu.

This chapter describes TTY emulation. If a different interface is selected, the control codes and escape sequences described in this chapter will no longer be applicable.

Example: The following escape sequences will select Printek emulation, load form one, and then return to the previous emulation.

Escape Sequence:	ESC	ESC	7	ESC	L	1	ESC	ESC	?
Hexadecimal:	1B	1B	07	1B	4C	01	1B	1B	3F

Control Codes and Escape Sequences
Sorted Alphabetically

BEL	Bell
BS	Backspace
CR	Carriage Return
ESC ESC *n*	Select Software Interface *n*
ETX	End of Text
FF	Form Feed
HT	Horizontal Tab
LF	Line Feed
VT	Vertical Tab

PRINTEK EMULATION

Introduction

This section describes the control codes and escape sequences comprising Printek emulation. This emulation may be selected by specifying "Mode: Printek" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 7** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

Some escape sequences accept one or more numeric parameters. If a sequence accepts one numeric parameter, it will be represented as "*n*". If a sequence accepts more than one numeric parameter, they will be represented as "*n1 n2 ... nx*".

Since numeric parameters are always encoded in one byte, their values may range from 0 to 255 decimal. Please note that the value will never be represented by a string of ASCII decimal digits ("0" through "9"). For example, a value of 66 decimal would be sent as a single byte with a hex value of 42. This is equivalent to sending the ASCII character "B". It is entirely different than sending the two printable ASCII characters "66".

If a numeric parameter is limited to a value of zero or one, it may be sent as a single byte with a value of 00 or 01 hex (NUL or SOH), or it may be sent as a single printable ASCII character "0" or "1" (30 or 31 hex).

Spaces are used when documenting escape sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*" and "*n1 n2*" above) are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **BS** is the Backspace control code (08 hex), not the two characters "B" and "S" (42 and 53 hex). An ASCII Control Code Table is contained in the appendices for your convenience. If you have any doubt about how to interpret a documented control code or escape sequence, refer to the hex representation in the

provided example. This should clarify any ambiguity. The examples may also be helpful when analyzing a hex dump (see chapter 8) printed by the printer.

Column and line numbers begin at zero, not at one. Keep this in mind when setting tabs, margins, etc.

Printek emulation was developed to allow access to the full range of hardware features available in the Printek FormsPro 4000. Other emulations typically support some character pitches, but not all character pitches. They do not allow the 10 different form setups to be selected via software, or allow graphics of every possible density to be printed. Printek emulation supports all of these features, and more, in one place. This makes Printek emulation the most powerful emulation available in the printer. We encourage you to take full advantage of all the unique features available in Printek emulation. After all, these features are the reason you purchased the FormsPro 4000. However, you should be aware that using these features may prevent your software from being easily portable to other printers. If you do not require the unique features available in Printek mode, it is probably wise to choose a different emulation that is more widely supported.

The most common reason for using Printek emulation is to select a different form setup (and thus change tractors). Many users switch to Printek emulation (using the **ESC ESC 7** sequence), load a new form (using the **ESC L *n*** sequence), and then return to their standard emulation (using the **ESC ESC *n*** sequence). If you normally use Epson emulation, please note that the Epson sequence **ESC EM *n*** allows Form 0, 1, or 2 to be selected without switching to Printek emulation.

Control Codes and Escape Sequences Grouped by Function

Communications

End of Text **ETX**

If "ETX/ACK: On" is specified in the "Setup: INTERFACE" menu, then receipt of an ETX causes the printer to transmit an ACK to the host computer.

Since the ETX may be a legal value within an escape sequence, it is the user's responsibility to ensure that an ETX used for data handshake is not sent within an escape sequence. The user must also ensure that the maximum block size or the number of blocks sent at one time does not exceed the input buffer size of the printer.

ETX/ACK handshake is available only with serial I/O. It is not available when using the parallel interface or the coaxial/twinaxial interface.

Control code: ETX
Hexadecimal: 03

Deselect Printer **DC3**
(or) **XOFF**

Deselects the printer. Use of this command is discouraged, because the printer will remain offline until an operator presses the ONLINE button on the control panel.

Control code: DC3
Hexadecimal: 13

Character Size

Set Character Spacing **ESC SP *n***

Sets character spacing in decipoints (*n*/720 of an inch). Overrides the "CPI:" value in the "Setup: FORM" menu. Supported values are shown in the following table.

n	Character Size
72	10 cpi
60	12 cpi
54	13.3 cpi
48	15 cpi
43	16.74 cpi
42	17.14 cpi
36	20 cpi

Example: The following escape sequence will select 10 cpi character spacing.

Escape Sequence:	ESC	SP	72
Hexadecimal:	1B	20	48

Double-Wide Mode **ESC W *n***

Selects double-wide mode for *n*=1, or cancels for *n*=0. Double-wide mode doubles the width of all characters, but does not affect character height. ESC S 3 may be used to select double-high mode.

Example: The following escape sequence will select double-wide mode.

Escape Sequence:	ESC	W	1
Hexadecimal:	1B	57	31

Select Script Modes **ESC S *n***

Selects normal character height for *n*=0, subscript mode for *n*=1, superscript mode for *n*=2, or double-high mode for *n*=3. This is shown in the following table.

n	Script Mode
0	Script modes off
1	Subscript
2	Superscript
3	Double high

Subscript mode will print characters about half the normal height in the bottom half of the normal character cell. Superscript mode will print characters about half the normal height in the top half of the normal character cell. Double-high mode doubles the height of all characters. These modes are mutually exclusive, and none of them affect character width.

Example: The following escape sequence will select double-high mode.

Escape Sequence:	ESC	S	3
Hexadecimal:	1B	53	03

Character Attributes

Emphasized Mode **ESC E *n***

Selects emphasized mode for *n*=1, or cancels for *n*=0. Emphasized mode makes characters bolder by printing an extra dot to the right of each dot normally found in the character matrix. This will cut the print speed in half, but will not require an additional pass of the print head. Overrides the "Impact:" value in the "Setup: FORM" menu.

Example: The following escape sequence will select emphasized mode.

Escape Sequence:	ESC	E	1
Hexadecimal:	1B	45	31

Double-Strike Mode **ESC D *n***

Selects double-strike mode for n=1, or cancels for n=0. Double-strike mode makes text bolder by printing it twice. This will cut the print speed in half, because an additional pass of the print head will be required.

Example: The following escape sequence will select double-strike mode.

Escape Sequence:	ESC	D	1
Hexadecimal:	1B	44	31

Underline Mode **ESC _ *n***

Selects underline mode for *n*=1, or cancels for *n*=0. This mode provides continuous underlining for all characters, including spaces.

Example: The following escape sequence will turn underlining on.

Escape Sequence:	ESC	_	1
Hexadecimal:	1B	5F	31

Character Sets

Select Font **ESC F *n***

Select font *n* according to the following table.

n	Font
0	Epson FX Draft
1	Epson FX Letter Quality
2	Proprinter Draft
3	Proprinter Letter Quality
10	EBCDIC Draft (optional)
11	EBCDIC Letter Quality (optional)
12	OCR-A Optical Quality (optional)
13	OCR-B Optical Quality (optional)
32	Epson FX Fast Draft
33	Epson FX Draft
34	Epson FX Letter Quality
36	Proprinter PC Fast Draft
37	Proprinter PC Draft
38	Proprinter PC Letter Quality
44	PC Latin II (Slavic) Fast Draft
45	PC Latin II (Slavic) Draft
46	PC Latin II (Slavic) Letter Qualit
64	EBCDIC Fast Draft
65	EBCDIC Draft
66	EBCDIC Letter Quality
71	OCR-A Optical Quality
75	OCR-B Optical Quality

Overrides the "Font:" value in the "Setup: FORM" menu. If the specified font is not installed, the "Font:" value in the "Setup: FORM" menu will be used to select the default font.

Example: The following escape sequence will select the Proprinter letter quality font.

Escape Sequence:	ESC	F	3
Hexadecimal:	1B	46	03

Print Single Character **ESC \ *n***

Prints the character *n* from the selected font. This sequence may be used to print a character that is normally treated as a control code.

Example: The following escape sequence will print a left arrow, if a Proprinter font is selected. This character is normally not printable, since it is treated as the ESC control code.

Escape Sequence:	ESC	\	ESC
Hexadecimal:	1B	5C	1B

Line Pitch

Set Line Spacing to *n*/288" **ESC LF *n***

Sets the line spacing to *n*/288 of an inch per line. $0 \geq n \geq 255$. Overrides the "LPI:" value in the "Setup: FORM" menu.

Example: The following escape sequence will set line spacing to 1/6 of an inch per line (6 lpi).

Escape Sequence:	ESC	LF	48
Hexadecimal:	1B	0A	30

Horizontal Position

Carriage Return **CR**

Causes the current line to be printed, and then sets the current print position to the left margin. If "Auto LF: On" is selected in the "Setup: INTERFACE" menu, a line feed will also be performed.

Control code: CR
Hexadecimal: 0D

Backspace **BS**

Causes the current line to be printed, and then moves the current print position one space to the left. The actual distance moved depends on the current character spacing. Backspacing can be done up to, but not beyond, the left margin.

Control code: BS
Hexadecimal: 08

Vertical Position

Line Feed **LF**

Causes the current line to be printed, and then advances the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code: LF
Hexadecimal: 0A

Reverse Line Feed **ESC ^**

Causes the current line to be printed, and then retracts the paper one line at the current line spacing. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Escape Sequence: ESC ^
Hexadecimal: 1B 5E

Form Length and Form Feed

Form length is the distance from the top of the form to the bottom of the form. A form feed will advance the paper to the top of the next form. Some programs do not send form feeds. Instead, they count line feeds, and send the appropriate number of line feeds to fill out the page. The usual rational is that the program is then in complete control of form length, and will work on any printer without requiring the correct form length to be set. However, the correct form length should always be set on the FormsPro 4000. Even if the program does not use form feeds, the printer will automatically scroll a completed form up to the tear bar to be torn off. This automatic scroll is based upon form length. The easiest way to set form length is via the "Length:" value in the "Setup: FORM" menu, so it will be correctly set for everyone using the form. If correct form length cannot be guaranteed from SETUP, then each program should set the correct form length.

Set Form Length in Lines **ESC FF *n***

Sets the form length to *n* lines at the current line spacing. $1 \geq n \geq 255$. Maximum form length is 37.9 inches. Invalid form lengths will be ignored. Overrides the "Length:" value in the "Setup: FORM" menu.

For example, an 11 inch form contains 66 lines at 6 LPI, but 88 lines at 8 LPI. If line spacing is changed after setting the form length, the physical form length (in inches) will not be changed.

Resets top of form to the current position, so it is wise to be at top of form before setting form length. Issuing a form feed will guarantee this. Vertical margins are cleared.

Example: The following escape sequence will set form length to 66 lines. At 6 LPI, this will result in a form length of 11 inches.

Escape sequence:	ESC	FF	66
Hexadecimal:	1B	0C	42

Form Feed **FF**

Causes the current line to be printed, and then advances the paper to the top of the next form. If a top margin is set, printing will continue at the top margin. The "FF at TOF: No" value in the "Setup: INTERFACE" menu allows a form feed to be ignored if the paper is already at top of form. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	FF
Hexadecimal:	0A

Horizontal Tabs

Default horizontal tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. The default tab stops are associated with columns, not absolute physical positions. Changing character spacing will change the physical position of the default tab stops.

User defined horizontal tab stops are associated with absolute physical positions, not with columns. The tab stops are set relative to the current character spacing, but subsequent changes in character spacing will not affect the physical position of the tab stops (except that the position will be rounded up to the closest character boundary).

Horizontal Tab **HT**

Advances to the next horizontal tab stop. If no tab stop exists between the active column and the right margin, the HT will be ignored. Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. Different tab stops may be set with ESC HT.

Control code:	HT
Hexadecimal:	09

Set Horizontal Tab Stops **ESC HT *n1 n2 ... nx* NUL**

Clears all currently set horizontal tab stops, and sets new tab stops at column *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops must be presented in ascending order. The NUL character, or any tab stop value less than the preceding one, terminates the sequence. The tab stops are set relative to the current character spacing, but subsequent changes in character spacing will not affect the physical position of the tab stops (except that the position will be rounded up to the closest character boundary). The leftmost column is column zero.

Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. The tab stops set by ESC HT will replace the default tab stops. ESC HT NUL will clear all tab stops, leaving no tab stops set. The default tab stops are restored by ESC R.

Example: The following escape sequence will set horizontal tab stops at half inch intervals, if character spacing is currently 10 cpi.

Escape Sequence:	ESC	HT	5	10	15	20	25	30	NUL
Hexadecimal:	1B	09	05	0A	0f	14	19	1E	00

Vertical Tabs

Vertical tab stops are associated with absolute physical positions, not with lines. The tab stops are set relative to the current line spacing, but subsequent changes in line spacing will not affect the physical position of the tab stops.

Vertical Tab **VT**

Causes the current line to be printed, and then advances the paper to the next vertical tab stop. If no vertical tab stops are set, then a line feed is done instead. If "Auto CR: On" is selected in the "Setup: INTERFACE" menu, a carriage return will also be performed.

Control code:	VT
Hexadecimal:	0B

Set Vertical Tab Stops **ESC VT *n1 n2 ... nx* NUL**

Clears all currently set vertical tab stops, and sets new tab stops at line *n1*, *n2*, *n3*, etc. $1 \geq n \geq 255$. The tab stops must be presented in ascending order. The NUL character, or any tab stop value less than the preceding one, terminates the sequence. The tab stop settings are based on the current line spacing. Changing the line spacing after the tab stops are set will not affect the position of the tab stops. The first line is line zero.

ESC VT NUL or ESC R will clear all currently set vertical tab stops, leaving no vertical tab stops set.

Example: The following escape sequence will set vertical tab stops at line 6, 12, and 24. If line spacing is currently 6 lpi, this will result in tab stops one inch, two inches, and four inches from the top of the form.

Escape Sequence:	ESC	VT	6	12	24	NUL
Hexadecimal:	1B	0B	06	0C	18	00

Horizontal and Vertical Tabs

Reset Horizontal and Vertical Tab Stops **ESC R**

Clears all currently set horizontal tab stops, and restores the default horizontal tab stops. Default horizontal tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc. Clears all currently set vertical tab stops.

Escape Sequence:	ESC	R
Hexadecimal:	1B	52

Horizontal Margins

Printing is allowed only within the left and right margins. Exceeding the right margin will cause line wrap, setting the current print position to the left margin and advancing the paper one line.

Set Left and Right Margin **ESC H *n1 n2***

Sets the left margin to column *n1* and the right margin to column *n2* at the current character spacing. $0 \geq n1 \geq 255$, $0 \geq n2 \geq 255$. If character spacing is changed after setting the margins, the position of the margins will not change.

The left margin is inclusive, but the right margin is exclusive. For example, a left margin at column 10 still allows a character to be printed in column 10. A right margin at column 75 allows a character to be printed in column 74, but not in column 75.

The leftmost column is column zero. The left margin must be left of the right margin and ≤13.4 inches. The right margin must be right of the left margin and ≤13.6 inches. Invalid margins will be ignored. Overrides the "Left Mar:" and "Right Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a one inch left margin, and will set a right margin 7.5 inches from the left edge of the form, if character spacing is currently 10 cpi. For a standard 8.5 inch wide form, this would result in a one inch right margin.

Escape Sequence:	ESC	H	10	75
Hexadecimal:	1B	48	0A	4B

Vertical Margins

Printing is allowed only within the top and bottom margins. Exceeding the bottom margin will set the current line to the top margin of the next form.

Set Top and Bottom Margins **ESC V *n1 n2***

Sets the top margin to line *n1* and the bottom margin to line *n2* at the current line spacing. $0 \geq n1 \geq 255$, $0 \geq n2 \geq 255$. If line spacing is changed after setting the margins, the position of the margins will not change. Vertical margins are cleared by ESC FF *n*.

The top and bottom margins are both inclusive. For example, a top margin at line 6 still allows text to be printed on line 6, but not on line 5. A bottom margin at line 59 still allows text to be printed on line 59, but not on line 60.

The first line is line zero. The top margin must be above the bottom margin. The bottom margin must be below the top margin. The margins cannot exceed the form length. Invalid margins will be ignored. Overrides the "Top Mar:" and "Btm Mar:" values in the "Setup: FORM" menu.

Example: The following escape sequence will set a top margin at line 6, and will set a bottom margin at line 59. For a standard 11 inch form with 6 lpi line spacing, this would result in one inch top and bottom margins.

Escape Sequence:	ESC	V	6	59
Hexadecimal:	1B	56	06	3B

Graphics

Graphics mode gives the user complete control over every dot position on the paper. Graphics may be printed with various horizontal densities from 60 to 240 dpi, and a vertical density of 72 dpi.

Each byte of graphics data represents a vertical column of eight dots, with the MSB (most significant bit) corresponding to the top wire of the print head. Turning a bit on causes a dot to be printed. The bit values corresponding to each wire of the print head are shown below:

wire 1	128	(80 hex)
wire 2	64	(40 hex)
wire 3	32	(20 hex)
wire 4	16	(10 hex)
wire 5	8	(08 hex)
wire 6	4	(04 hex)
wire 7	2	(02 hex)
wire 8	1	(01 hex)

The appropriate bit values are added together to fire the desired wires. For example, a byte of graphics data with the value 128 (80 hex) will fire the top wire, wire 1. A value of 192 (C0 hex) will fire the top two wires, wires 1 and 2. A value of 11 (0B hex) will fire wires 5, 7 and 8.

Each graphics sequence contains two bytes (*n1* and *n2*) that specify how many bytes of graphics data follow. *N2* can specify values up to 255. If that is sufficient, then *n1* is just set to zero. For values greater than 255, *n1* comes into play. The *n1* byte specifies multiples of 256. For example, to specify 520 bytes of graphics data, use *n2* = 8 and *n1* = 2. The bytes of graphics data are strung together to create a graphics line that is eight dots high, and (*n1* x 256) + *n2* dots long. Be sure to provide the amount of graphics data that you specify, because the printer will not leave graphics mode until it has accepted the specified number of data bytes.

If "Data Bits: 7" is specified in the "Setup: INTERFACE" menu, beware of potential problems in graphics mode. Since the MSB (most significant bit) will always be turned off, it will not be possible to fire the top wire of the print head. Worse yet, the value of *n1* or *n2* may be changed. For example, if *n1* specifies 200 bytes of data, and its MSB is turned off, the printer will only expect 72 bytes of data. It will exit graphics mode, and then try to print the remaining 128 bytes of graphics data as normal text characters. The result will surely not be pretty. To avoid such problems, the use of an 8-bit I/O interface for printing graphics is highly recommended.

The normal graphics modes allow every dot to be printed. High speed graphics will print twice as fast, but will not allow consecutive dots to be printed.

m DPI Graphics — ESC * *m n1 n2 data*

Selects eight wire graphics of density *m* as listed in the following table for *n2* + (*n1* x 256) columns of data.

m	Density
6	240 dpi
7	240 dpi high speed
8	180 dpi
9	180 dpi high speed
10	144 dpi
11	144 dpi high speed
12	120 dpi
13	120 dpi high speed
14	102.86 dpi
15	102.86 dpi high speed
16	90 dpi
17	90 dpi high speed
18	80 dpi
19	80 dpi high speed
20	72 dpi
21	72 dpi high speed
22	65.45 dpi
23	65.45 dpi high speed
24	60 dpi
25	60 dpi high speed

NOTE: Horizontal movement of the FormsPro 4000 print head is measured in intervals of 1/720 of an inch. Every supported graphics density above is an integral multiple of this resolution. For example, at 60 dpi, dots may be printed every 12/720 of an inch.

Example: The following escape sequence will print four bytes of graphics data at 72 x 72 dpi. The resulting figure will resemble a square, since the horizontal and vertical density are the same. If some other density is chosen, the figure will resemble a rectangle.

Escape Sequence:	ESC	*	20	0	4	<	<	<	<
Hexadecimal:	1B	2A	14	00	04	3C	3C	3C	3C

_m_ DPI Graphics **ESC # _m n1 n2 data_**

Selects eight wire graphics of density *m* as listed in the following table for *n2* + (*n1* x 256) columns of data.

m	Density
90	90 dpi
100	100 dpi
135	135 dpi
150	150 dpi

NOTE: Horizontal movement of the FormsPro 4000 print head is measured in intervals of 1/720 of an inch. The supported graphics densities above may not be an integral multiple of this resolution. For example, at 150 dpi, dots may be printed every 4.8/720 of an inch. The printer is not really capable of printing dots every 4.8/720 of an inch. It will print the dots as accurately as possible, with some at 4/720 of an inch and some at 5/720 of an inch. The overall average will be 4.8/720 of an inch.

Example: The following escape sequence will print five bytes of graphics data at 150 dpi. The resulting figure will resemble a backslash character, "\".

Escape Sequence:	ESC	#	150	0	5	64	32	16	8	4
Hexadecimal:	1B	23	96	00	05	40	20	10	08	04

Printer Controls

Bell **BEL**

Causes the printer's bell to sound.

Control code: BEL
Hexadecimal: 07

Unidirectional Mode **ESC U *n***

Selects unidirectional mode for *n*=1, or bidirectional mode for *n*=0. Printing is normally bidirectional. Unidirectional printing provides more accurate positioning, but causes lower throughput.

Example: The following escape sequence will force unidirectional printing.

Escape Sequence:	ESC	U	1
Hexadecimal:	1B	55	31

Automatic Modes **ESC A *n***

Selects automatic modes according to the following table.

n	Mode
0	Automatic modes off
1	Automatic carriage return
2	Automatic line feed
3	Both (1 and 2)

Automatic carriage return mode causes the printer to automatically perform a carriage return (CR) for each line feed (LF), vertical tab (VT), or form feed (FF) that it receives. Overrides the "Auto CR:" value in the "Setup: INTERFACE" menu.

Automatic line feed mode causes the printer to automatically perform a line feed (LF) for each carriage return (CR) it receives. Overrides the "Auto LF:" value in the "Setup: INTERFACE" menu.

Example: The following escape sequence will select automatic carriage return mode.

Escape Sequence:	ESC	A	1
Hexadecimal:	1B	41	01

AutoCut **ESC B *n***

Selects Auto Cut On for *n*=1, or Auto Cut Off for *n*=0 for the currently selected form if the optional Printek FormsCutter is installed. When Auto Cut is turned on, the FormsCutter will automatically cut off each form as it is ejected from the printer.

Example: The following escape sequence will select Auto Cut = On.

Escape Sequence:	ESC	B	1
Hexadecimal:	1B	42	31

Cut Form **ESC C**

Ejects the current form and cuts it off if the optional Printek FormsCutter is installed.

Escape Sequence:	ESC	C
Hexadecimal:	1B	43

Reset **ESC @**

Deletes all data on the current line and initializes the printer to the default settings for the current form.

Restores the default horizontal tab stops. Default tab stops are set at every eighth column, i.e. column 8, 16, 24, 32, 40, etc.

Resets top of form to the current position, so it is wise to be at top of form before performing this reset. Issuing a form feed will guarantee this.

See the appendix on Printer Reset Conditions for more information.

Escape Sequence:	ESC	@
Hexadecimal:	1B	40

Forms and Tractors

The FormsPro 4503 contains three sets of paper tractors (front, center, and rear). It is possible, via software, to change to a different set of tractors and continue printing.

You may change to a different set of tractors by selecting a different form. The "Path:" value in the "Setup: FORM" menu specifies "Front", "Center", or "Rear" for each form that is defined. When a form is selected, the associated set of tractors is also automatically selected.

Load Form **ESC L *n***

Causes the current line to be printed, and then loads paper and form parameters for form *n*. $0 \geq n \geq 9$. If form *n* is already loaded, this sequence is ignored. If not, the current form will be unloaded, the parameters for form *n* will be selected, and the printer will go offline to wait for the operator to install the new form and place the printer back online. In the FormsPro 4503 the same happens unless selecting form *n* also selects a different paper path. In that case, the current form is unloaded, the tractors are moved to engage the new path, the new form is loaded, and printing may continue.

The printer will not unload the current form if a previously printed form has not been torn off. In this case, the printer will go offline, sound the bell, and display the message "Tear Off Paper". When an operator tears off the paper and places the printer back online, the printer will unload the current form and continue.

If the printer is unable to load the new form, it will sound the bell and display the message "No Paper to Load". A "Paper Out" error will occur and the printer will go offline to wait for an operator to clear the error.

Example: The following escape sequence will load form 2.

Escape Sequence:	ESC	L	2
Hexadecimal:	1B	4C	32

Emulations

Select Software Interface *n* **ESC ESC *n***

Selects the software interface *n* according to the table below.

n	Software Interface
0	Test (reserved for factory use)
1	ANSI X3.64 Emulation
2	Epson FX Emulation
3	Bar Code Mode (optional)
4	IBM Proprinter Emulation
5	DEC LA120 Emulation
6	TTY Emulation
7	Printek Emulation
?	Previously Selected Emulation
@	Default Emulation

Overrides the "Mode:" value in the "Setup: INTERFACE" menu. "Mode: BarberPole" and "Mode: Hex Dump" cannot be overridden.

A numeric value for *n* may be specified in two different ways, with equivalent results: a single byte with a value of 00 to 07 hex, or a single printable ASCII character "0" to "7" (30 to 37 hex).

If more than one emulation has been selected, ESC ESC ? will return to the previously selected emulation. This is particularly useful when the previous emulation is unknown. Please beware that the memory (stack) is only one level deep.

ESC ESC @ will return to the default emulation, as specified by the "Mode:" value in the "Setup: INTERFACE" menu.

This chapter describes Printek emulation. If a different interface is selected, the control codes and escape sequences described in this chapter will no longer be applicable.

Example: The following escape sequences will select Printek emulation, load form one, and then return to the previous emulation.

Escape Sequence:	ESC	ESC	7	ESC	L	1	ESC	ESC	?
Hexadecimal:	1B	1B	07	1B	4C	01	1B	1B	3F

Control Codes and Escape Sequences
Sorted Alphabetically

BEL	Bell
BS	Backspace
CR	Carriage Return
DC3	Deselect Printer
ESC # *m n1 n2 data*	*m* DPI Graphics
ESC * *m n1 n2 data*	*m* DPI Graphics
ESC @	Reset
ESC A *n*	Automatic Modes
ESC D *n*	Double-Strike Mode
ESC E *n*	Emphasized Mode
ESC ESC *n*	Select Software Interface *n*
ESC F *n*	Select Font
ESC FF *n*	Set Form Length in Lines
ESC G *n*	Modify Print Head Gap
ESC H *n1 n2*	Set Left and Right Margin
ESC HT *n1 n2 ... nx* NUL	Set Horizontal Tab Stops
ESC I *n*	Set Print Head Force
ESC L *n*	Load Form
ESC LF *n*	Set Line Spacing to *n*/288"
ESC R	Reset Horizontal and Vertical Tab Stops
ESC S *n*	Select Script Modes
ESC SP *n*	Set character Spacing
ESC U *n*	Unidirectional Mode
ESC V *n1 n2*	Set Top and Bottom Margins
ESC VT *n1 n2 ... nx* NUL	Set Vertical Tab Stops
ESC W *n*	Double-Wide Mode
ESC \ *n*	Print Single Character
ESC ^	Reverse Line Feed
ESC _ *n*	Underline Mode
ETX	End of Text
FF	Form Feed
HT	Horizontal Tab
LF	Line Feed
VT	Vertical Tab
XOFF	Deselect Printer

HEX DUMP MODE

Hex dump mode provides a way to print, in a readable form, all the data received by the printer. This tool is useful to programmers for diagnosing problems with control codes and escape sequences sent to the printer. Hex dump mode may also be used to detect what commands are being sent by a particular software application to help determine which emulation mode is needed for that application.

To select hex dump mode, specify the value "Mode: Hex Dump" in the "Setup: INTERFACE" menu. Be sure to note the emulation currently being used before changing it to "Hex Dump".

A sample hex dump is shown below. Note that each line shows sixteen characters, first in hexadecimal format, then in printable ASCII format. All unprintable ASCII characters (printable characters are from 21 hex to 7E hex inclusive) are represented by a period.

```
54686973 20697320 61207361 6D706C65     This.is.a.sample
20686578 2064756D 7020746F 20696C6C     .hex.dump.to.ill
75737472 61746520 68657820 64756D70     ustrate.hex.dump
666F726D 61740D0A                       format..
```

When the printer is executing in hex dump mode, control characters and escape sequences sent to the printer are not recognized or processed. The hexadecimal representation of the control characters and escape sequences will appear in the hex dump, but no other special processing will occur.

In particular, note that ETX/ACK handshake will not operate properly in hex dump mode. When an ETX is received by the printer, its hexadecimal representation will be printed in the hex dump, but no ACK will be sent to the host computer. When using the printer in hex dump mode, it is recommended that the printer be configured for parallel I/O, serial I/O with hardware handshake, or serial I/O with XON/XOFF handshake.

To exit hex dump mode, restore the previous "Mode:" value in the "Setup: INTERFACE" menu.

OPTIONAL
COAXIAL/TWINAXIAL INTERFACE

Introduction

This appendix describes the automatic port switching between the coaxial/twinaxial port and the parallel port available as a part of this interface (this interface replaces the printer's standard parallel interface). This appendix also describes how to send control codes and escape sequences to the printer through the coaxial/twinaxial port. For information on installation and configuration of this interface, please refer to the FormsPro 4000 Series Operator's Manual.

Automatic Port Switching

For your convenience, a parallel interface is also provided as part of the coaxial/twinaxial interface. The interface will automatically switch to receive data from either the coaxial/twinaxial port or the parallel port after the time out specified on the configuration dip switches (SW1-7 & SW1-8).

The automatic switching will perform a Form Feed and reset the printer to the appropriate configuration as described in the following paragraphs each time a switch occurs. Some of the extra form feeds may be suppressed by selecting "FF at TOF: No" in the Interface menu. The automatic switching may cause unexpected results if escape sequences are being used and there are pauses longer than the specified time out in the data stream.

When data is received at the coaxial/twinaxial port, the interface will automatically switch the printer to Printek emulation and select the EBCDIC font. Therefore, the control codes and escape sequences described in the Printek Emulation chapter apply when received at this port. How to send control codes and escape sequences to the printer through the coaxial/twinaxial port is described below in the "Coaxial/Twinaxial Command Interpreter" section.

When data is received at the parallel port, the interface will automatically switch the printer to the default emulation selected in the Interface menu and select the default parameters set for the current form in the Forms menu. In this case, the control codes and escape sequences described in the chapter for the default emulation apply.

Command Interpreter

A user friendly command interpreter has been built into the coaxial/twinaxial interface. This feature allows you to send any hexadecimal character or string of characters to the printer through the coaxial/twinaxial port.

The logical not character (¬) used below may be shown as the carat (^) on some keyboards. Either character is usually the accessed as a SHIFT-6 on the main keyboard.

The command interpreter is enabled by receiving "¬ ONN" and disabled by receiving "¬ OFF". The default is "¬ OFF".

If enabled, the command interpreter examines all printable data received from the host for the string "¬ HEX" Once this string is found, then all EBCDIC characters following are converted to hexadecimal and sent to the printer. The conversion process is terminated by receiving an "@" character. Receiving any non-hexadecimal character during the conversion process will also terminate the conversion. Spaces may be included between pairs of hex digits for readability.

Example: The following string will cause the interface command interpreter to send the ESC L *n* sequence (see the "Forms and Tractors" section in the Printek emulation chapter) to the printer to load form number two.

Turn the command interpreter on by sending

¬ ONN

then send

¬ HEX 1B 4C 32 @

in which the hexadecimal character 1B is an Escape character, the hexadecimal character 4C is the ASCII character "L", and the hexadecimal character 32 is the ASCII character "2".

The command interpreter should now be turned off by sending

¬ OFF

to prevent any inadvertent triggering of the interpreter by random combinations of data.

To assist in verifying that the proper EBCDIC characters are being sent to the coaxial/twinaxial port from the host, refer to the interface diagnostics section in the

coaxial/twinaxial appendix in the Operator's Manual for information on how to use the Code Dump mode of the interface.

To verify that the interface is sending the correct ASCII characters to the printer, see the Hex Dump chapter in this manual.

PRINTING BASIC BAR CODES

Introduction

This section describes the control codes and escape sequences comprising bar code emulation. This emulation may be selected by specifying "Mode: Bar Codes" in the "Setup: INTERFACE" menu, or via software with the **ESC ESC 3** sequence. While this emulation is selected, control codes and escape sequences from other emulations are not available.

Control codes and escape sequences are used to control printer operation. An ASCII control code is a single character in the range 00 hex through 1F hex, and 7F hex. The **ESC** (Escape) control code (1B hex) is used to introduce character strings called escape sequences, which provide an extension of the commands available with ASCII control codes.

The bar code interface was designed to primarily use printable ASCII characters, instead of relying on control codes and escape sequences. The printable ASCII caret character "^" is used to introduce most bar code sequences.

Spaces are used when documenting sequences to increase readability. The spaces within the sequences are for readability only; they are not part of the sequences themselves. Characters that appear in *italics* (such as "*n*") are not sent to the printer as is; they are used as a place holder indicating that some value must be supplied.

Multiple character strings without intervening spaces typically represent control codes. For example, **FF** is the Form Feed control code (0C hex), not two "F" characters (46 46 hex). An ASCII Control Code Table with hexadecimal equivalents is contained in the appendices for your convenience. This may be helpful when analyzing a hex dump printed by the printer.

Please note that bar code emulation is essentially a graphics preprocessor, whose sole purpose is to print bar codes. It is not possible to print normal text in bar code emulation. In order to mix text and bar codes, the text must be printed in some other emulation, before or after the bar codes are printed in bar code emulation.

The Printek FormsPro 4000 series printers internally support the following types of basic bar codes:

Code 39 1:1:2:2 Ratio

Code 39 1:1:3:3 Ratio

Code 39 1:2:4:5 Ratio

Code 39 1:1:2.5:2.5 Ratio (LOGMAR Standard Density)

Code 39 1.5:1.5:3.5:3.5 Ratio (LOGMAR Medium Density)

Code 39 2:2:4.5:4.5 Ratio (LOGMAR Low Density)

2-of-5 1:1:3:X Ratio

2-of-5 1:2:3:X Ratio

Interleaved 2-of-5 BS Code 1:1:3:3 Ratio

Interleaved 2-of-5 BS Code 1:2:4:5 Ratio

Interleaved 2-of-5 BS Code 1.5:1.5:4.5:4.5 Ratio

Interleaved 2-of-5 BS Code 2:2:6:6 Ratio

Interleaved 2-of-5 C Code 1:1:2:2 Ratio

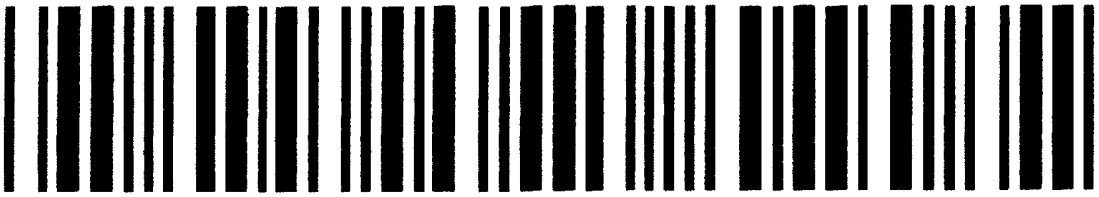
Interleaved 2-of-5 C Code 1:1:2.5:2.5 Ratio

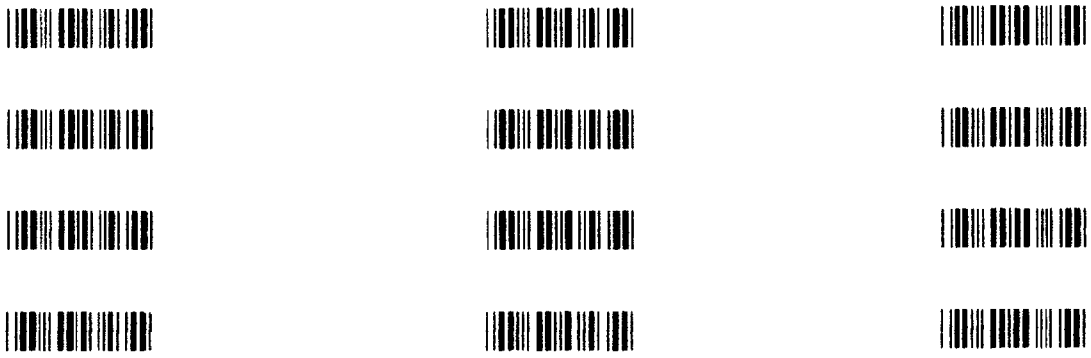
Interleaved 2-of-5 C Code 1.5:1.5:3.5:3.5 Ratio

Interleaved 2-of-5 C Code2:2:4.5:4.5 Ratio

These bar codes can be automatically printed with the use of a few simple bar code sequences. The height of the bar codes is easily varied. Additionally, the dimensions of the bars and spaces may be varied to produce bar codes of different widths and ratios.

Horizontal and vertical positioning sequences allow precise placement of a bar code on a label, or placement of multiple bar codes across and down the page.





Bar Code Sequences

To print bar codes, the following sequences are used in bar code mode:

BAR CODE SEQUENCE	FUNCTION
BEL	Sound the Bell.
ESC ESC *n*	Change Emulation Mode
ETX	ETX/ACK Software Handshake.
FF	Form Feed.
LF	Fractional Line Feed (to next line boundary)
^BNxccc...c^G	Horizontal Bar Code.
^BN9xddddccc...c^G	Variable Width Horizontal Bar Code.
^Htt	Bar Code Height.
^Jttd	Relative Vertical Tab.
^Ttttd	Absolute Horizontal Tab.
^-	Bar Code Pass Terminator.

These bar code sequences are described in detail in the following sections.

Measurements in Bar Code Mode

All measurements in bar code mode are specified in tenths of an inch and/or dots.

Bar codes are printed with a graphics resolution of 144 dots per inch both horizontally and vertically.

All references to tenths of an inch are in actuality 14/144's of an inch.

All references to dots are in actuality 1/144's of an inch. The range of dots that may be specified is 0 to 15. This range is represented using hexadecimal convention. The ASCII characters '0' to '9' represent 0 to 9 dots, respectively. The ASCII characters 'A' to 'F', and 'a' to 'f', represent 10 to 15 dots, respectively.

Entering/Exiting Bar Code Mode

Bar code mode is entered by sending the escape sequence: ESC ESC ETX (27 27 03 decimal, 1B 1B 03 hex).

Bar code mode is used only to process the bar code sequences described in this document. While in bar code mode, other printable text, text mode escape sequences and control characters, graphics data, and graphics mode escape sequences and control characters should not be sent to the printer.

To exit bar code mode, use the sequence ESC ESC ? (27 27 63 decimal, 1B 1B 3F hex) to return to the previously selected emulation mode, or you may use a different ESC ESC *n* sequence to select a different emulation mode.

The Bar Code Control Character

Except for a few ASCII control characters supported by bar code mode, all bar code sequences are introduced by the "bar code control character". The "bar code control character" is the printable ASCII caret character "^" (94 decimal, 5E hex).

Note in particular that the ESC control code (27 decimal, 1B hex) is not used in bar code mode. When the caret character "^" is seen in this chapter, it does not mean ESC and it does not mean "control-_" !

Other Control Characters

BEL is processed and causes the printer to ring the bell. This is supported so that you may annoy the printer operator without exiting bar code mode.

ETX is processed so that ETX/ACK software handshake will work in bar code mode. (As an aside, XON/XOFF software handshake will also work in bar code mode. However, XON/XOFF characters are transmitted only from the printer to the host; XON/XOFF characters should not be sent to the printer.)

FF is supported so that you may easily reach top of form without exiting bar code mode.

LF advances the paper to the next line feed boundary at the currently selected line pitch. If already positioned at a line feed boundary, this will peform a full line feed, if not a partial line feed will be performed to position the paper at the next line. This allows the paper to be positioned properly for text printing after bar code mode is exited.

All other control characters are ignored in bar code mode.

Bar Code Definition

The sequence used to define a horizontal bar code is

^BNxccc...c^G

^B	Two Character Sequence Identifier for Horizontal Bar Code Definition.
N	Reserved Parameter.
x	Bar Code Type. "a" = Code 39 1:1:2:2 Ratio "b" = Code 39 1:1:3:3 Ratio "c" = Code 39 1:2:4:5 Ratio "d" = Code 39 LOGMAR Standard Density "e" = Code 39 LOGMAR Medium Density "f" = Code 39 LOGMAR Low Density "g" = 2-of-5 1:1:3:X Ratio "h" = 2-of-5 1:2:3:X Ratio "i" = Interleaved 2-of-5 BS Code 1:1:3:3 Ratio "j" = Interleaved 2-of-5 BS Code 1:2:4:5 Ratio "k" = Interleaved 2-of-5 BS Code 1.5:1.5:4.5:4.5 Ratio "l" = Interleaved 2-of-5 BS Code 2:2:6:6 Ratio "m" = Interleaved 2-of-5 C Code 1:1:2:2 Ratio "n" = Interleaved 2-of-5 C Code 1:1:2.5:2.5 Ratio "o" = Interleaved 2-of-5 C Code 1.5:1.5:3.5:3.5 Ratio "p" = Interleaved 2-of-5 C Code2:2:4.5:4.5 Ratio
ccc...c	Characters to be Bar Coded.
^G	Sequence Terminator. Required to signal end of character data.

The width of a defined bar code is predetermined by the definition of the bar code type. The width of all bars and spaces is automatically set.

Example:

The following sequence defines a Code 39 LOGMAR bar code of standard density. The characters "12345" are encoded in the bar code.

^BNd12345^G^-

Example:

The same character data is represented below in a low density LOGMAR bar code.

^BNf12345^G^-

Variable Width Bar Code Definition

The sequence used to define a variable width, horizontal bar code is

^BN9xddddccc...c^G

^B	Two Character Sequence Identifier for Horizontal Bar Code Definition.
N	Reserved Parameter.
9	Flags Variable Width.
x	Bar Code Type. "a" = Code 39 1:1:2:2 Ratio "b" = Code 39 1:1:3:3 Ratio "c" = Code 39 1:2:4:5 Ratio "d" = Code 39 LOGMAR Standard Density "e" = Code 39 LOGMAR Medium Density "f" = Code 39 LOGMAR Low Density "g" = 2-of-5 1:1:3:X Ratio "h" = 2-of-5 1:2:3:X Ratio "i" = Interleaved 2-of-5 BS Code 1:1:3:3 Ratio "j" = Interleaved 2-of-5 BS Code 1:2:4:5 Ratio "k" = Interleaved 2-of-5 BS Code 1.5:1.5:4.5:4.5 Ratio "l" = Interleaved 2-of-5 BS Code 2:2:6:6 Ratio "m" = Interleaved 2-of-5 C Code 1:1:2:2 Ratio "n" = Interleaved 2-of-5 C Code 1:1:2.5:2.5 Ratio "o" = Interleaved 2-of-5 C Code 1.5:1.5:3.5:3.5 Ratio "p" = Interleaved 2-of-5 C Code2:2:4.5:4.5 Ratio
dddd	Width of all Bars and Spaces. Includes Number of Dots in: Narrow Bar, Narrow Space, Wide Bar, Wide Space; respectively. Range of d is 0 to F (0 to 15 dots).
ccc...c	Characters to be Bar Coded.
^G	Sequence Terminator. Required to signal end of character data.

When defining a variable width bar code, first choose a bar code type that matches the desired bar code. Then specify the width of the bars and spaces to achieve the desired bar code density and wide:narrow ratios.

Example:

Bar code type "a" defines a rather dense Code 39 bar code with 1:1:2:2 ratio.

^BNa12345^G^-

The following sequence will print the same bar code, except the bar code will be four times as wide.

^BN9a448812345^G^-

Example:

Note that when choosing the bar code type off which the variable width bar code will be based, ratio is irrelevant. If a 2-of-5 bar code with ratio 3:3:9:9 (not supported directly) is desired, it may be derived from bar code types “g” and “h”. The following variable width bar code definitions all produce exactly the same result.

^BN9g339912345^G^-

^BN9h339912345^G^-

Choosing any other bar code type will not achieve the desired result. The following bar code has the desired ratio, but it is a Code 39 instead of a 2-of-5 bar code.

^BN9a339912345^G^-

Bar Code Height

The sequence used to specify bar code height is

^Htt

^H	Two Character Sequence Identifier for Bar Code Height.
tt	Height, in Tenth Inches. Range is 01 to 99 (0.1 to 9.9 inches).

If this sequence is not used, default bar code height is 0.3 inches. All bar codes printed together horizontally across the page must be the same height. If height is specified more than once, the latest specified height will be used.

Example:

To print a bar code that is only 0.1 inch high.

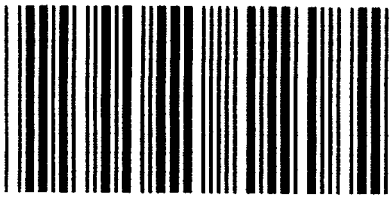
^H01^BNe12345^G^-

It would generally not be desireable to print a bar code with such a short height, because scanning of the bar code would be difficult. In most cases, the wider the bar code, the higher the bar code for ease of scanning

Example:

To print a bar code that is 1.0 inch high.

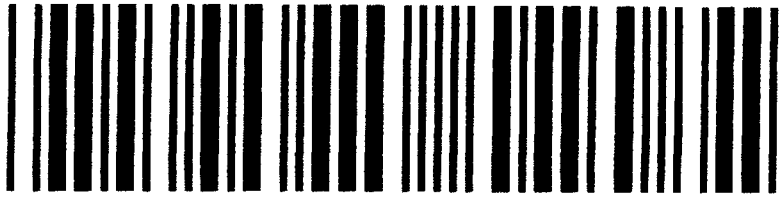
^H10^BNe12345^G^-



Example:

Note that increasing the height of a bar code has no effect on the width of the bar code. To print a very large bar code, both the height and the width may need to be increased. The following sequences double the width of the medium density LOGMAR bar code, while also increasing its height.

^H10^BN9e337712345^G^-



Relative Vertical Tab

The sequence used to skip vertical space is

^Jttd

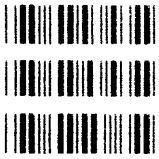
^J	Two Character Sequence Identifier for Relative Vertical Tab.
ttd	Vertical Distance, in Tenth Inches plus Dots. Range of tt is 00 to 99 (0.0 to 9.9 inches). Range of d is 0 to F (0 to 15 dots).

The distance specified is relative to the current vertical position.

Example:

To print multiple bar codes down the page. Each bar code is 0.2 inches high, and is separated from other bar codes by 0.1 inch of white space.

^H02^BNd01^G^-^J010^BNd02^G^-^J010^BNd03^G^-



Absolute Horizontal Tab

The sequence used for horizontal positioning is

^Ttttd

^T	Two Character Sequence Identifier for Absolute Horizontal Tab.
tttd	Horizontal Distance, in Tenth Inches plus Dots. Range of ttt is 000 to 136 (00.0 to 13.6 inches). Range of d is 0 to F (0 to 15 dots).

The horizontal position specified is an absolute distance, with respect to the left edge of the paper. Remember that a tenth of an inch is actually 14/144ths of an inch, so the actual distance tabbed may be slightly shorter than expected.

Example:

To print multiple bar codes across the page. Bar codes are printed approximately 0, 2, and 4 inches from the left edge of the paper.

^H02^BNd01^G^T0200^BNd02^G^T0400^BNd03^G^-

Bar Code Pass Terminator

The sequence used to terminate a bar code pass is ^-.

A bar code pass may contain vertical tabs (should precede all bar code definitions), height specification, bar code definitions, horizontal tabs, etc. Until the bar code pass terminator is received, no bar codes will be printed. When the pass terminator is received, all bar codes defined for the pass will be printed.

The following examples will help clarify use of the pass terminator. Note the very different results obtained by omitting or inserting the pass terminators.

Example:

To print multiple bar codes across the page.

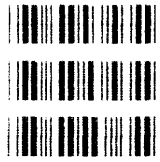
^H02^BNd01^G^T0200^BNd02^G^T0400^BNd03^G^- (Correct)

^H02^BNd01^G^-^T0200^BNd02^G^-^T0400^BNd03^G^- (Incorrect)

Example:

To print multiple bar codes down the page.

^H02^BNd01^G^-^J010^BNd02^G^-^J010^BNd03^G^- (Correct)



^H02^BNd01^G^J010^BNd02^G^J010^BNd03^G^- (Incorrect)

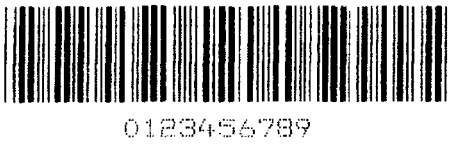
Note that one bar code pass may not contain multiple bar codes separated by vertical tabs.

Mixing Bar Codes and Text

By combining the capabilities of text mode and bar code mode, it is possible to print text above, below, and along side bar codes.

Example:

To print a human-readable interpretation beneath a bar code. The characters "0123456789" are encoded in the following Code 39 standard density LOGMAR bar code.



This bar code and interpretation was printed by first entering bar code mode and printing the bar code. While still in bar code mode, a relative vertical tab was done to space 0.1 inch below the bar code.

^H05^BNd0123456789^G^-^J010

Then, after returning from bar code mode to text mode, the character string " 0123456789" was printed.

Example:

To print text along side a bar code.

Text to left of bar code. Text to right of bar code.

To print this bar code and text, all text was first printed:

```
"Text to left                          Text to right"
"of bar code.                          of bar code."
```

While still in text mode, reverse paper motion was done to step back above the printed text. The bar code was then printed in bar code mode.

^H05^T0140^BNd0123456789^G^-

Description of Supported Bar Code Types

Code 39

The Code 39 character set contains 43 characters: 0-9, A-Z, -, ., $, /, +, %, and space. A maximum bar code density of approximately 5.5 characters per inch (using type "a") may be obtained.

The printer automatically inserts a narrow space between all valid data characters. Invalid data characters will cause blank space to be inserted in the bar code. A common character (*) is used for both start and stop delimiters. The printer will automatically insert the start/stop delimiter before and after each bar code string. Check digits are not automatically generated by the printer. If a check digit is to be used, it must be included in the bar code data by the programmer.

2-of-5

The 2-of-5 character set contains 10 characters, the decimal digits 0-9. A maximum bar code density of approximately 5.2 characters per inch (using type "g") may be obtained.

The printer automatically inserts a narrow space between all valid data characters. Invalid data characters will cause blank space to be inserted in the bar code. The printer will automatically insert the start delimiter before and the stop delimiter after each bar code string. Check digits are not automatically generated by the printer. If a check digit is to be used, it must be included in the bar code data by the programmer.

Interleaved 2-of-5

Interleaved 2-of-5 bar codes encode information in both the bars and spaces in order to create a denser bar code. There are two techniques used to perform this interleave.

One technique takes the bars of an individual character and interleaves them into the spaces to create a narrower character. Since each character is interleaved individually, an even or odd number of characters may be interleaved without a problem. This technique is referred to as bar/space interleave, and is abbreviated in the previous tables as BS code.

The second and more popular technique takes the bars of two adjacent characters and interleaves them together. All of the odd positioned characters are encoded in the bars and all of the even positioned characters are encoded in the spaces. The interleaving process requires an even number of characters to work correctly. This technique is referred to as character interleave and is abbreviated in the previous tables as C code.

The two types of interleaved 2-of-5 are not compatible and bar code readers designed to read one type will probably not read the other.

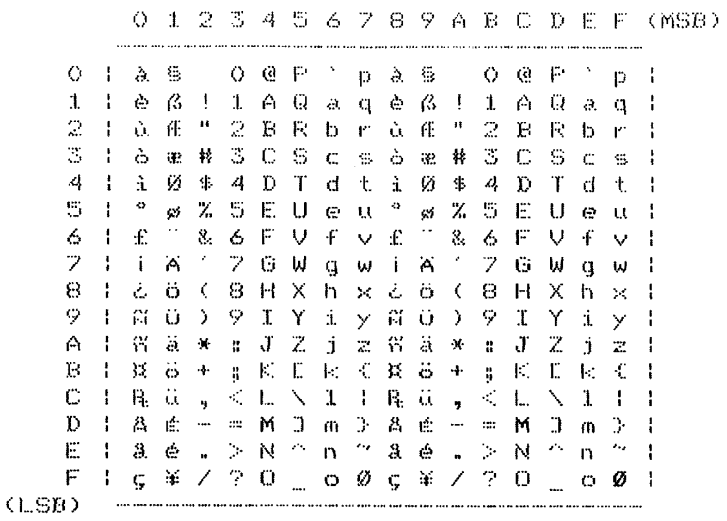
ASCII CHARACTER TABLES

ASCII Control Code Definitions

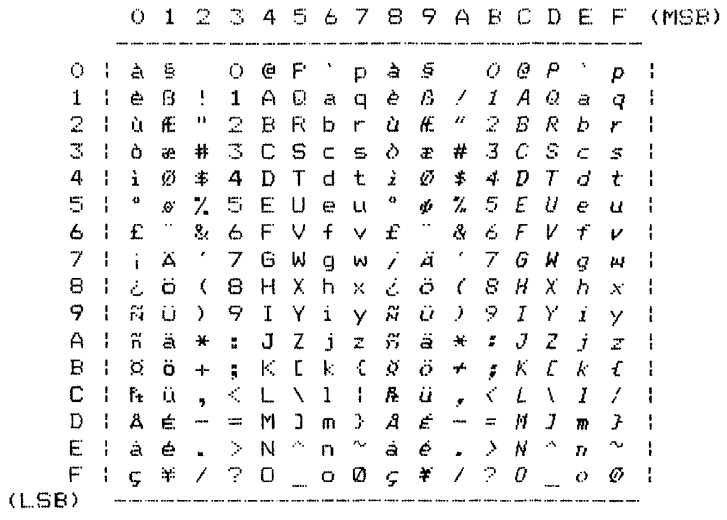
The following table is provided as a reference to the control character descriptions as provided by the ASCII definition. Not all of these definitions are supported by the FormsPro 4000 and some are emulation dependent. For more information consult the appropriate chapter for the emulation being used and/or the chapter on Input/Output Control Codes.

Control Code	Hexadecimal Value	Description
NUL	00	Null
SOH	01	Start of Heading
STX	02	Start of Text
ETX	03	End of Text
EOT	04	End of Transmission
ENQ	05	Enquiry
ACK	06	Acknowledge
BEL	07	Bell
BS	08	Backspace
HT	09	Horizontal Tabulation
LF	0A	Line Feed
VT	0B	Vertical Tabulation
FF	0C	Form Feed
CR	0D	Carriage Return
SO	0E	Shift Out
SI	0F	Shift In
DLE	10	Data Link Escape
DC1	11	Device Control 1 (XON)
DC2	12	Device Control 2
DC3	13	Device Control 3 (XOFF)
DC4	14	Device Control 4
NAK	15	Negative Acknowledge
SYN	16	Synchronous Idle
ETB	17	End of Transmission Block
CAN	18	Cancel
EM	19	End of Medium
SUB	1A	Substitute
ESC	1B	Escape
FS	1C	File Separator
GS	1D	Group Separator
RS	1E	Record Separator
US	1F	Unit Separator

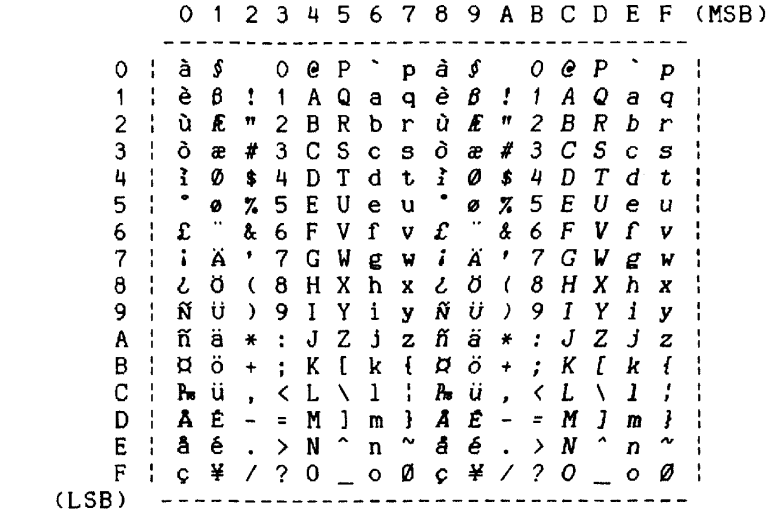
Epson FX Fast Draft

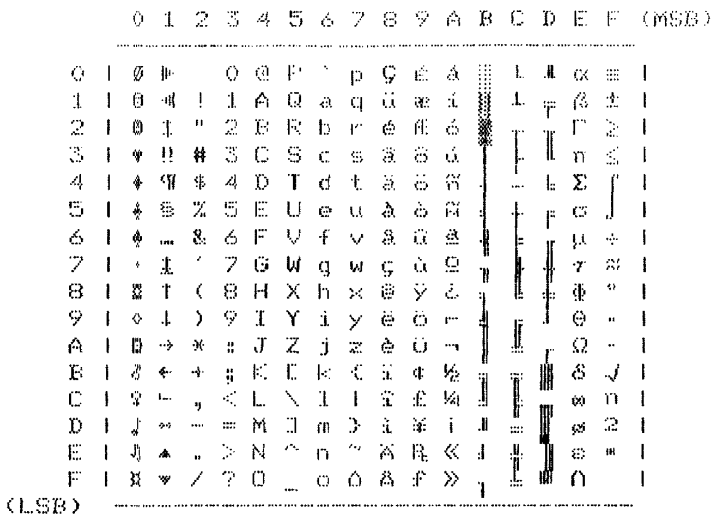


Epson FX Draft

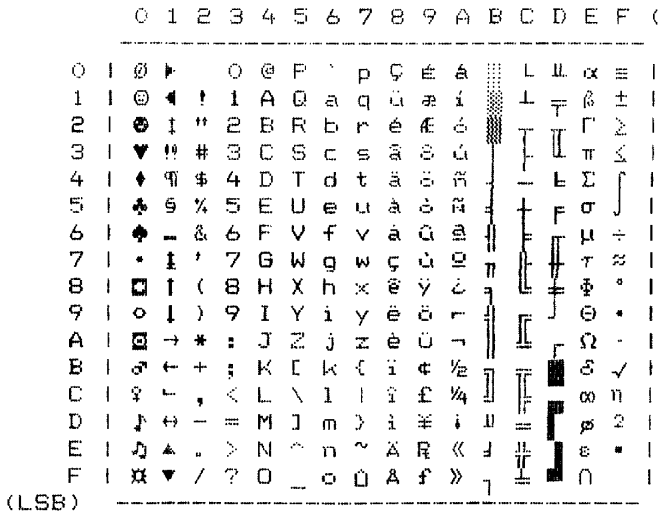


Epson FX Letter Quality

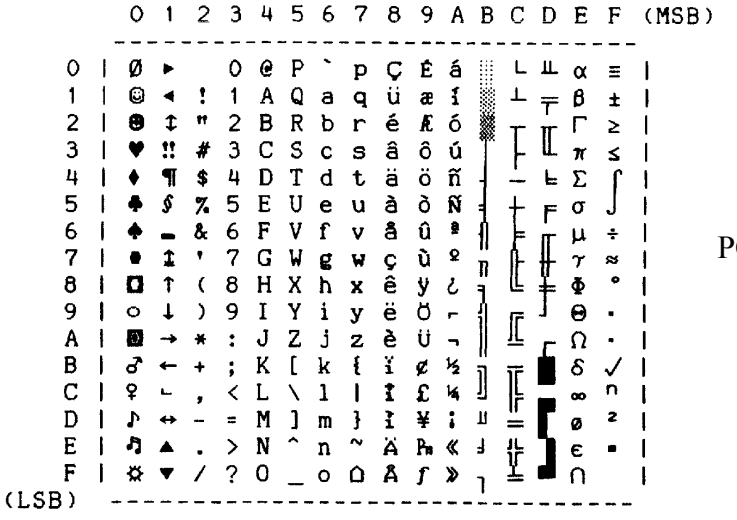




PC Fast Draft

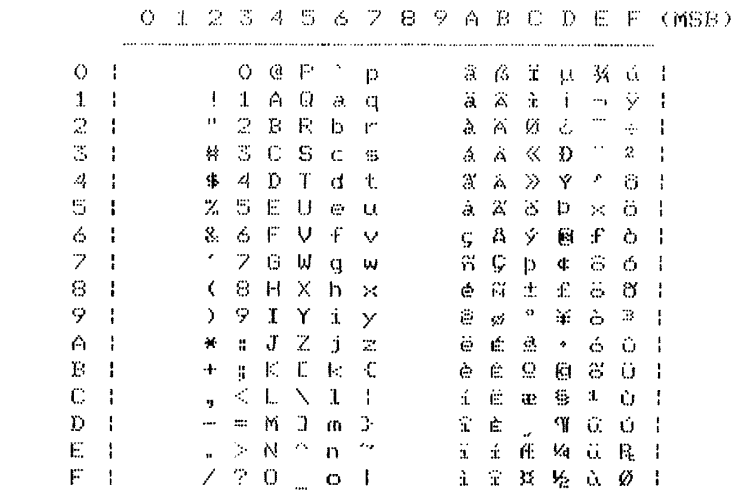


PC Draft

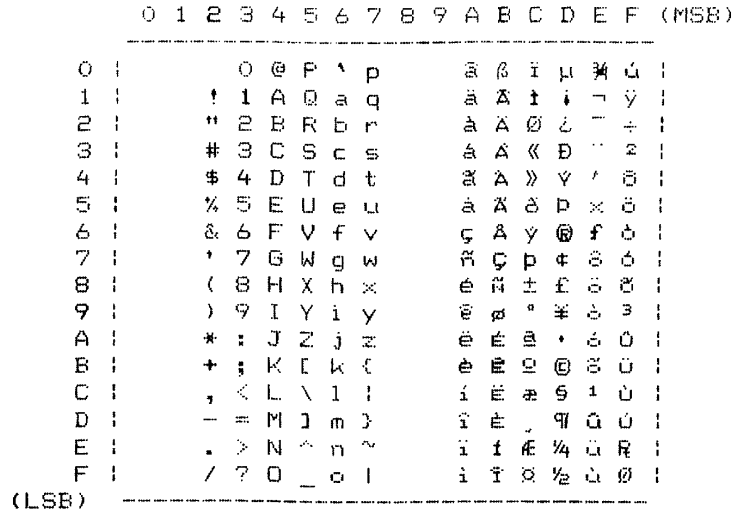


PC Letter Quality

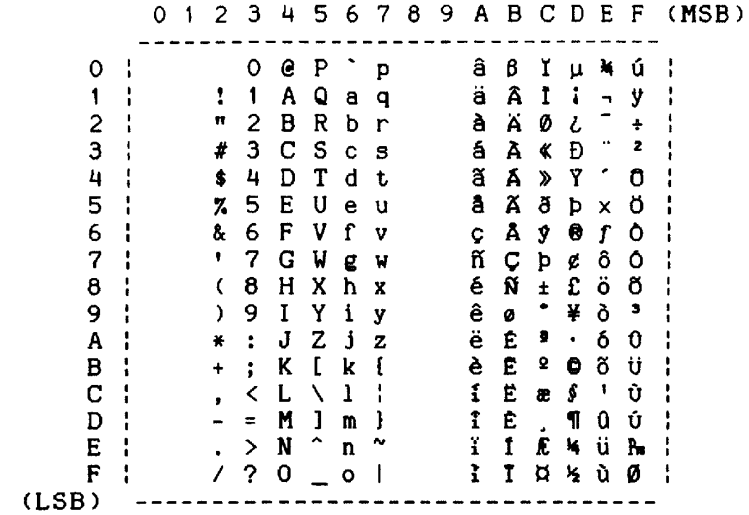
EBCDIC Fast Draft

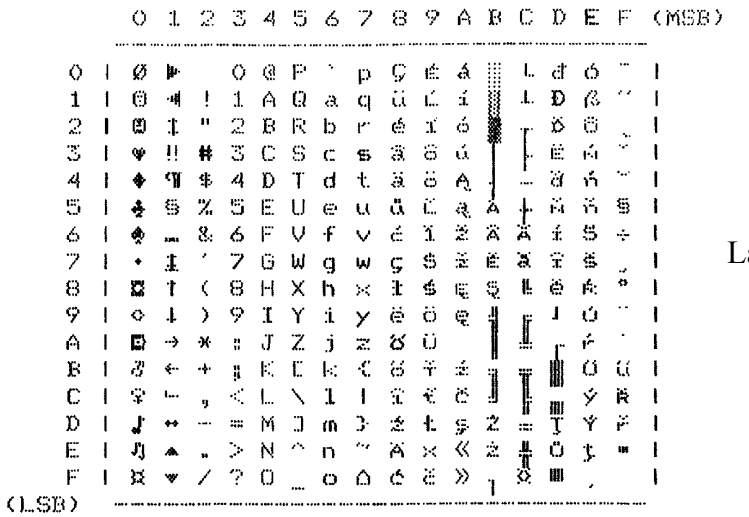


EBCDIC Draft

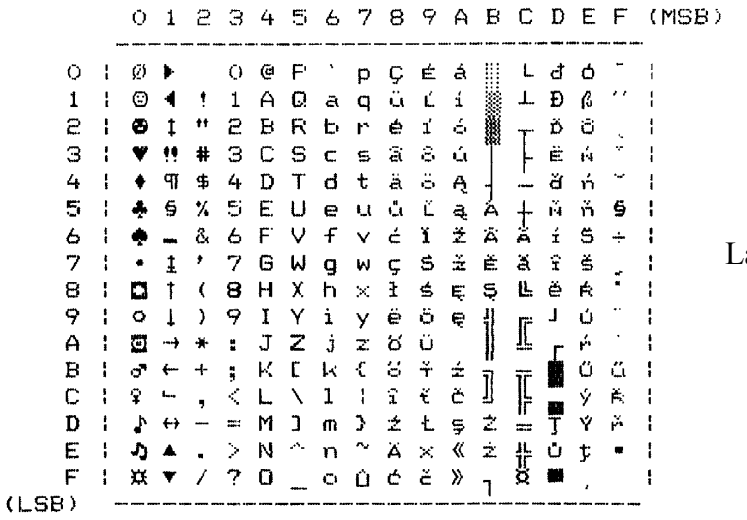


EBCDIC Letter Quality

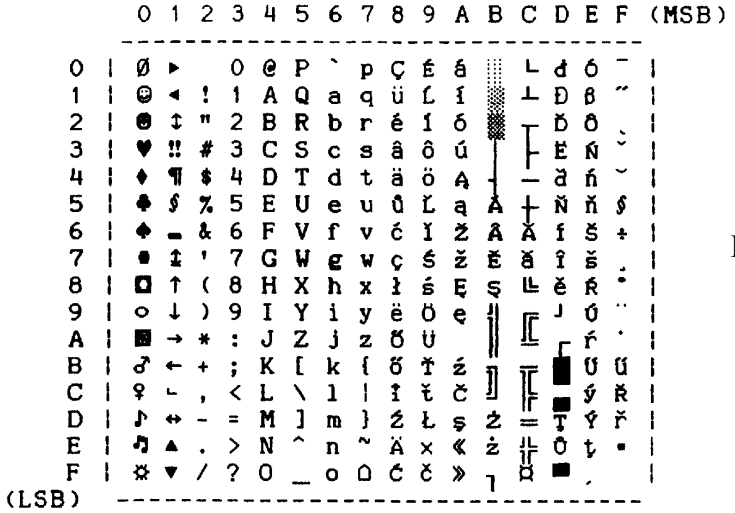




Latin 2 (Slavic) Fast Draft

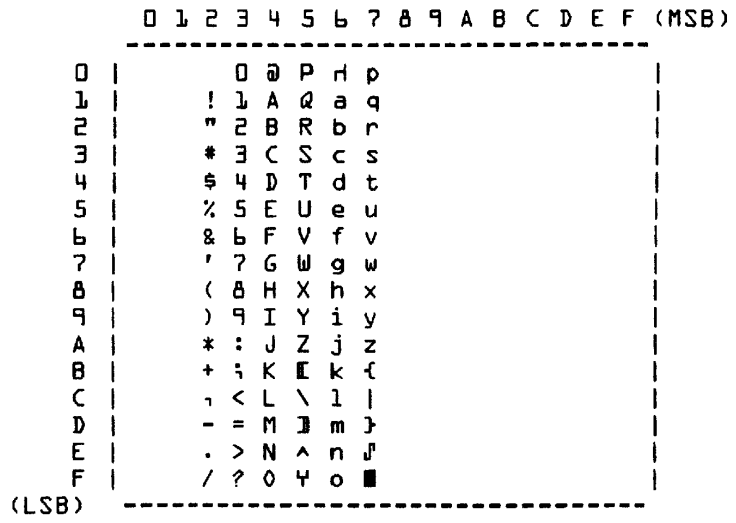


Latin 2 (Slavic) Draft



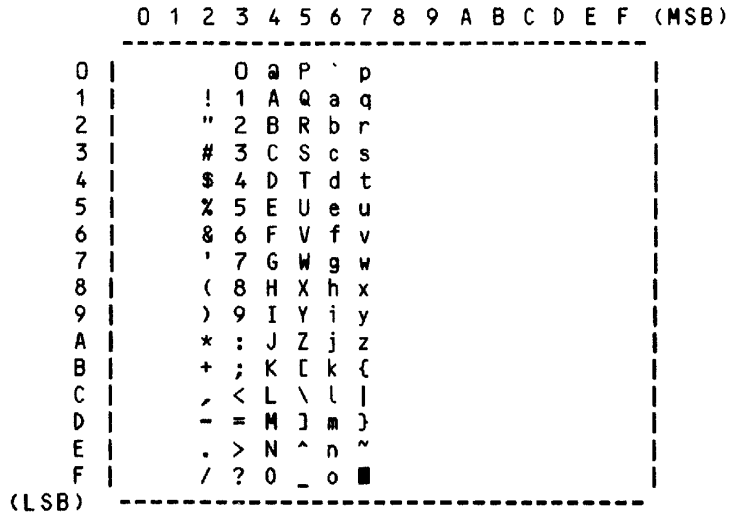
Latin 2 (Slavic) Letter Quality

OCR A Font



(LSB)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	(MSB)
0				0	@	P	`	p									
1			!	1	A	Q	a	q									
2			"	2	B	R	b	r									
3			#	3	C	S	c	s									
4			$	4	D	T	d	t									
5			%	5	E	U	e	u									
6			&	6	F	V	f	v									
7			'	7	G	W	g	w									
8			(	8	H	X	h	x									
9			)	9	I	Y	i	y									
A			*	:	J	Z	j	z									
B			+	;	K	[	k	{									
C			,	<	L	\	l	|								
D			-	=	M	]	m	}									
E			.	>	N	^	n	~									
F			/	?	O	_	o	■									

OCR B Font



(LSB)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	(MSB)
0				0	@	P	`	p									
1			!	1	A	Q	a	q									
2			"	2	B	R	b	r									
3			#	3	C	S	c	s									
4			$	4	D	T	d	t									
5			%	5	E	U	e	u									
6			&	6	F	V	f	v									
7			'	7	G	W	g	w									
8			(	8	H	X	h	x									
9			)	9	I	Y	i	y									
A			*	:	J	Z	j	z									
B			+	;	K	[	k	{									
C			,	<	L	\	l	|								
D			-	=	M	]	m	}									
E			.	>	N	^	n	~									
F			/	?	O	_	o	■									

Decimal to Octal to Hexadecimal Conversion Table

Dec	Oct	Hex	Char	Dec	Oct	Hex	Char	Dec	Oct	Hex	Dec	Oct	Hex
0	000	00	NUL	64	100	40	@	128	200	80	192	300	C0
1	001	01	SOH	65	101	41	A	129	201	81	193	301	C1
2	002	02	STX	66	102	42	B	130	202	82	194	302	C2
3	003	03	ETX	67	103	43	C	131	203	83	195	303	C3
4	004	04	EOT	68	104	44	D	132	204	84	196	304	C4
5	005	05	ENQ	69	105	45	E	133	205	85	197	305	C5
6	006	06	ACK	70	106	46	F	134	206	86	198	306	C6
7	007	07	BEL	71	107	47	G	135	207	87	199	307	C7
8	010	08	BS	72	110	48	H	136	210	88	200	310	C8
9	011	09	HT	73	111	49	I	137	211	89	201	311	C9
10	012	0A	LF	74	112	4A	J	138	212	8A	202	312	CA
11	013	0B	VT	75	113	4B	K	139	213	8B	203	313	CB
12	014	0C	FF	76	114	4C	L	140	214	8C	204	314	CC
13	015	0D	CR	77	115	4D	M	141	215	8D	205	315	CD
14	016	0E	SO	78	116	4E	N	142	216	8E	206	316	CE
15	017	0F	SI	79	117	4F	O	143	217	8F	207	317	CF
16	020	10	DLE	80	120	50	P	144	220	90	208	320	D0
17	021	11	XON	81	121	51	Q	145	221	91	209	321	D1
18	022	12	DC2	82	122	52	R	146	222	92	210	322	D2
19	023	13	XOFF	83	123	53	S	147	223	93	211	323	D3
20	024	14	DC4	84	124	54	T	148	224	94	212	324	D4
21	025	15	NAK	85	125	55	U	149	225	95	213	325	D5
22	026	16	SYN	86	126	56	V	150	226	96	214	326	D6
23	027	17	ETB	87	127	57	W	151	227	97	215	327	D7
24	030	18	CAN	88	130	58	X	152	230	98	216	330	D8
25	031	19	EM	89	131	59	Y	153	231	99	217	331	D9
26	032	1A	SUB	90	132	5A	Z	154	232	9A	218	332	DA
27	033	1B	ESC	91	133	5B	[	155	233	9B	219	333	DB
28	034	1C	FS	92	134	5C	\	156	234	9C	220	334	DC
29	035	1D	GS	93	135	5D	]	157	235	9D	221	335	DD
30	036	1E	RS	94	136	5E	^	158	236	9E	222	336	DE
31	037	1F	US	95	137	5F	_	159	237	9F	223	337	DF
32	040	20	SP	96	140	60	`	160	240	A0	224	340	E0
33	041	21	!	97	141	61	a	161	241	A1	225	341	E1
34	042	22	"	98	142	62	b	162	242	A2	226	342	E2
35	043	23	#	99	143	63	c	163	243	A3	227	343	E3
36	044	24	$	100	144	64	d	164	244	A4	228	344	E4
37	045	25	%	101	145	65	e	165	245	A5	229	345	E5
38	046	26	&	102	146	66	f	166	246	A6	230	346	E6
39	047	27	'	103	147	67	g	167	247	A7	231	347	E7
40	050	28	(	104	150	68	h	168	250	A8	232	350	E8
41	051	29	)	105	151	69	i	169	251	A9	233	351	E9
42	052	2A	*	106	152	6A	j	170	252	AA	234	352	EA
43	053	2B	+	107	153	6B	k	171	253	AB	235	353	EB
44	054	2C	,	108	154	6C	l	172	254	AC	236	354	EC
45	055	2D	-	109	155	6D	m	173	255	AD	237	355	ED
46	056	2E	.	110	156	6E	n	174	256	AE	238	356	EE
47	057	2F	/	111	157	6F	o	175	257	AF	239	357	EF
48	060	30	0	112	160	70	p	176	260	B0	240	360	F0
49	061	31	1	113	161	71	q	177	261	B1	241	361	F1
50	062	32	2	114	162	72	r	178	262	B2	242	362	F2
51	063	33	3	115	163	73	s	179	263	B3	243	363	F3
52	064	34	4	116	164	74	t	180	264	B4	244	364	F4
53	065	35	5	117	165	75	u	181	265	B5	245	365	F5
54	066	36	6	118	166	76	v	182	266	B6	246	366	F6
55	067	37	7	119	167	77	w	183	267	B7	247	367	F7
56	070	38	8	120	170	78	x	184	270	B8	248	370	F8
57	071	39	9	121	171	79	y	185	271	B9	249	371	F9
58	072	3A	:	122	172	7A	z	186	272	BA	250	372	FA
59	073	3B	;	123	173	7B	{	187	273	BB	251	373	FB
60	074	3C	<	124	174	7C	|	188	274	BC	252	374	FC
61	075	3D	=	125	175	7D	}	189	275	BD	253	375	FD
62	076	3E	>	126	176	7E	~	190	276	BE	254	376	FE
63	077	3F	?	127	177	7F	DEL	191	277	BF	255	377	FF

PRINTER RESET CONDITIONS

The following list describes what conditions are assumed whenever the printer is powered on, the SETUP mode is exited, or a reset escape sequence is received when the printer is operating in an emulation mode which supports such a sequence.

This list includes all variables which may be modified by the user for all emulations even though some emulations cannot modify all the variables shown. Refer to the appropriate chapter for the emulation being used.

Variable	Reset Condition
tractor path	according to form setup
character pitch	according to form setup
left margin	according to form setup
line pitch	according to form setup
form length	according to form setup
top margin	according to form setup
bottom margin	according to form setup
scroll distance	according to form setup
font	according to form setup
impact force	according to form setup
impact mode	according to form setup
language	according to form setup
normal/slashed zero	according to form setup
top of form	set to current position
text in an incomplete line	discarded
input buffer	cleared (unless reset from host)
control of data bit 8	accepted as received
control character symbols	according to interface setup
italics	off
compressed	off
double strike	off
double wide	off
elite	off
emphasized	off
superscript/subscript	off
underline	off

GLOSSARY

ANSI	American National Standards Institute.
ASCII	American Standard Code for Information Interchange.
baud rate	The rate at which characters are transmitted over a serial interface. This is usually the same as bits per second.
binary	Base two numbering system. Digits are represented by the characters 0 and 1.
bit	A single binary digit.
control code	A single, non-printing character which is used to control the configuration or operation of the printer.
character pitch	The horizontal spacing of characters. Measured in cpi.
cpi	Characters per inch.
cps	Characters per second.
current line	The line upon which the next character will be printed.
current print position	The column on the current line where the next character will be printed.
default	Value or configuration assumed when the printer is powered on or reset.
dpi	Dots per inch. Generally used to refer to graphics density or resolution.
draft	Refers to the draft (high speed) font.
EBCDIC	Extended Binary Coded Decimal Interchange Code.
escape sequence	String of characters beginning with the escape (ESC) character which is used to control the configuration or operation of the printer. The characters which are part of this string are not printed.
font	A group of characters of a given shape or style.

hexadecimal	Base sixteen numbering system. Digits are represented by the characters 0 through 9 and a through f.
interface	The connection between the printer and the host computer.
LCD	Liquid crystal display.
LED	Light emitting diode.
line pitch	The vertical spacing of characters. Measured in lpi.
lpi	Lines per inch.
LQ	Letter Quality.
MSB	Most significant bit. In a character, this refers to bit seven (of 0 to 7).
octal	Base eight numbering system. Digits are represented by the characters 0 through 7.
off-line	Refers to the state of the printer when the "ONLINE" indicator is off and the printer does not respond to the host computer.
on-line	Refers to the state of the printer when the "ONLINE" indicator is on and the printer is responding to the commands and text received from the host computer.
OQ	Optical Quality.
parity	A method used for detecting errors within a single character transmitted or received via an interface.
reset	Initialization of various operating parameters of the printer to the value or state assumed when the printer is powered on.
top of form	The vertical position where the first line is printed on the paper. Also the position the paper is advanced to when a form feed (FF) character is received from the host or the Form Feed button is pressed on the printer's control panel.
tractors	Devices which control the movement of the paper through the printer.